The Western Australian Biodiversity Science Institute

Nature on the balance sheet

Research priorities to better understand biodiversity economics and finance

Acknowledgements

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Acknowledgement of Country

We acknowledge the traditional custodians throughout Western Australia and their continuing connection to, and deep knowledge of, the land and waters. We pay our respects to Elders both past and present.

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Contents

Foreword

The natural systems that provide our food, clean water, and stable climate are collapsing: the decisions we make in response will determine whether our children inherit a world teeming with life or one defined by empty monoculture, silent oceans, and far fewer opportunities.

Yet we also stand at a moment of unprecedented opportunity: we know what needs to be done, and we're beginning to understand how to turn the intention of nature-positive societies and economies into a reality. Thriving economies within Planetary Boundaries are achievable. International frameworks like the Kunming-Montreal Global Biodiversity Framework set a direction of travel, but real conservation happens locally, in specific places, with the communities who know them, using knowledge that works.

Western Australia, from its ancient karri forests through arid rangelands to the Kimberley's coral atolls, contains a remarkably high level of globally valuable and endemic biodiversity. The homegrown solutions developed here for biodiversity valuation and mainstreaming can inform and inspire the world on how to manage threats to a biodiversity hotspot and build prosperity in harmony with nature.

This program brings together Traditional Owners, researchers, government, financial institutions, and communities to tackle questions no single group can answer alone. The research priorities in biodiversity economics and finance, including measuring and valuing biodiversity and nature, developing financing instruments, assessing nature-related risks, and ensuring Indigenous communities benefit fairly, require economic innovation, policy reform, and genuine partnership with those who have stewarded these lands for millennia.

Our economy must transform. Prosperity depends on healthy nature. Destroying ecosystems for short-term gain is economically irrational.

To everyone engaging with this work: what you contribute matters. The knowledge, tools, and solutions you create will build an economy that works with nature, not against it. Western Australia has the knowledge, the partnerships, and the urgency to lead. What happens here matters for the world.

JESSICA SMITH

Head of Nature & Academic Engagement Lead, United Nations Environment Programme Finance Initiative

KEITH TUFFLEY AM

Board Member of EO Wilson Biodiversity Foundation, awarded a Member of the Order of Australia for significant service to conservation and environmental sustainability, and to the financial sector Geneva, Switzerland

Executive summary

Better management of nature and biodiversity is urgently needed. While there is ongoing work to reform environmental laws and implement Australia's Strategy for Nature 2024–2030, there is a growing need to understand how economic activity impacts nature and biodiversity, and what the dependencies, risks and opportunities are.

This need coincides with the emerging reality that 'nature on the balance sheet' is no longer just a concept. Business cash flows are closely linked to flows of services from nature.[1] The loss of nature and biodiversity is emerging as a material financial risk to businesses. Western Australia is uniquely placed in this context, as it has a unique nature as well as globally endemic and endangered biodiversity. Additionally, its economic activities are heavily dependent on nature. Assessments of the state of biodiversity suggest that threatening processes are continuing, resulting in the continued loss of biodiversity. Addressing knowledge gaps in understanding and mainstreaming biodiversity and nature in economic and financial decisions is thus urgently needed to contribute to a nature-positive future, while maintaining a thriving economy and improving the well-being of Western Australians.

Approach: Identification of knowledge gaps

To develop the Biodiversity Economics and Finance Research Program, WABSI adopted a structured, bottom-up and iterative approach aligned with its program development pathway. End-users and researchers were consulted throughout the process. Following initial consultations, four key sectors were identified: primary production, resources, services and financial. Stakeholders from these sectors helped define the program scope, identify and prioritise knowledge gaps, and shape the research framework. In November 2024, WABSI held four workshops to identify sectoral issues and challenges, which were analysed and translated into knowledge gaps. Two follow-up prioritisation workshops in June 2025 ranked these gaps at both overall and sectoral levels, resulting in the final set of research priorities for the Biodiversity Economics and Finance Research Program.

1 Nature refers to all life on Earth together with the geology, water, climate and all other inanimate components – both biotic and abiotic components. Biodiversity is a component of nature and specifically refers to all living organisms – genes, species, ecosystems – and the complex ecological processes they are part of. This document is focused on biodiversity, but nature and natural capital are also frequently used when biodiversity is referred to, inclusive of all its components.

Framework: Development of a prioritised research plan

Extensive engagement with end-users and researchers informed the research framework architecture and prioritised research plan.

Key questions we asked:

- What do we know about the role of biodiversity in day-to-day business activities?
- How do we measure biodiversity in a consistent and robust way?
- What are the cost-effective measurement metrics, approaches and tools for biodiversity?
- What are the diverse values of biodiversity?
- How do we account for the biodiversity and the stocks and flows of natural capital to help decision-making?
- What enabling conditions are in place to integrate biodiversity into private and public decisions?
- How do we scale up financing biodiversity conservation, using what mechanisms and products?
- What is the cost of inaction to biodiversity loss?
- How do we make the nature repair market robust and effective?
- What are the demand and supply-side factors of biodiversity certificates or credits?
- What tools, frameworks and standards are available, or need to be developed, to measure, account for and value biodiversity by different economic sectors?
- How do we mainstream biodiversity considerations in private and public sector decision-making?

The research framework prioritised the knowledge gaps under two themes (understanding and mainstreaming) and nine focus areas (learn, measure, value, account for, enabler, economics, markets, finance and practice).

Prioritisation: Knowledge gaps

This document outlines a prioritised research plan for the Biodiversity Economics and Finance Research Program for Western Australia, with specific objectives and outcomes for each focus area at both overall and sectoral levels. The overall research prioritisation provides a collective perspective on biodiversity economics and finance knowledge gaps, while the sectoral prioritisation provides sector-specific knowledge gap priorities for the same within the primary production, resources, services and financial sectors (Table E1).

TABLE E1. Overall and sectoral research prioritisation for the Biodiversity Economics and Finance Research Program (in number: 1 highest priority, 9 lowest priority; in colour: the darker the shade of green, the higher the priority, the darker the colour ochre, the lower the priority)

Theme	Focus area	Outcome	Objectives	Overall priority	Sectoral priority			
					Primary production	Resources	Services	Financial
Understanding	Learn	The research end-users and key stakeholders would have clearly understood the link between biodiversity and businesses and be able to articulate the need to integrate biodiversity into (land use or business) decisions.	• Understand the link between biodiversity and businesses (across sectors). • Develop clarity on emerging concepts of biodiversity economics and finance. • Understand land use interventions, ecological interactions and their economic implications.	5	1	9	9	5
	Measure	Improved biodiversity measurement, monitoring and data sharing with the use of standardised and robust measurement methods, metrics and indicators	• Develop fit-for-purpose biodiversity measurement methods and data metrics for different land use and business contexts. • Develop frameworks and guidance to improve biodiversity measurement. • Develop insights from new and existing biodiversity data to support decision-making.	3	4	2	4	4
	Value	The diverse (market and non-market, including cultural and spiritual) values of biodiversity would be understood by research end-users and stakeholders for various contexts (businesses) and sectors, along with understanding of biodiversity valuation approaches.	• Develop fit-for-purpose biodiversity valuation methods. • Assess biodiversity valuation from different perspectives and world views, including the Indigenous perspective. • Understand diverse values of biodiversity.	2	3	1	3	2
	Account for	The contributions of biodiversity or nature would be accounted for using robust methodologies following a consistent or interoperable natural capital accounting framework for a range of land uses and business contexts to aid decision-making.	• Develop and pilot a natural capital accounting framework to document the contribution of nature or biodiversity for different land uses in different (business) contexts. • Develop tools or frameworks to integrate natural capital or biodiversity at varying scales into businesses and public sector decisions.	4	7	3	2	7

TABLE E1. Overall and sectoral research prioritisation for the Biodiversity Economics and Finance Research Program (in number: 1 highest priority, 9 lowest priority; in colour: the darker the shade of green, the higher the priority, the darker the colour ochre, the lower the priority)

Theme	Focus area	Outcome	Objectives	Overall priority	Sectoral priority			
					Primary production	Resources	Services	Financial
Mainstreaming	Enabler	Through research program implementation, the enabling environment would be enhanced based on cross-sector collaborations, including integration of Indigenous knowledge systems and relevant policy frameworks.	• Strengthen collaboration with government, industry and key stakeholders to improve and develop enabling conditions to consider biodiversity as an integral part of decision-making. • Create an enabling environment for biodiversity markets, integration of Indigenous knowledge systems, and develop skills and capacity for enhanced biodiversity conservation.	7	6	6	8	6
	Economics	The end-users or key stakeholders would be aware of the economic benefits of biodiversity and costs associated with its loss through a better understanding of the link between biodiversity, economic activity, and human well-being, thereby providing a rationale to integrate biodiversity into economic decisions.	• Quantify the costs of inaction to biodiversity loss in multiple land uses, economic sectors and business contexts. • Estimate the benefits of biodiversity protection from an economic as well as other (cultural and spiritual) perspectives. • Examine the interconnections between biodiversity, economic activity and human well-being.	1	2	5	1	1
	Market	A sound understanding of the biodiversity market (credits or certificates), including demand, supply, risks and price uncertainty would be developed for its proper functioning.	• Understand the demand and supply-side factors of the biodiversity market for Western Australia. • Conduct market analysis of biodiversity credits or certificates with a focus on risks and price uncertainty. • Identify dominant players of the biodiversity market and market risks.	8	8	7	6	8
	Finance	The state of biodiversity finance for Western Australia would be understood alongside the potential investors' expectations and risk profiles, and the development of biodiversity financing products.	• Develop a business case for investing in biodiversity or nature. • Estimate the existing biodiversity finance in Western Australia through different mechanisms (public, private, philanthropic, blended etc.). • Understand the implementation challenges and impact of biodiversity-focused financial products. • Understand the biodiversity risk appetite of investors, different sectors or businesses, and governments.	6	5	4	5	3
	Practice	Biodiversity considerations would become an integral part of private and public decisions across the sectors and businesses, supported by decision-making frameworks, tools and policy measures.	• Understand the potential of mainstreaming biodiversity across various sectors in Western Australia. • Assess the effect of regulatory measures to mainstream biodiversity. • Understand challenges and potential solutions in embedding biodiversity considerations in decision-making as well as in business practices.	9	9	8	7	9

Summary: Key priorities

Stakeholders identified the following focus areas as the areas of greatest need for targeted biodiversity economics and finance research.

- **Economics:** Greater awareness of the economic benefits of biodiversity and nature, and the costs associated with its loss, through a better understanding of the link between biodiversity, economic activity and human well-being, thereby providing a rationale to integrate biodiversity into economic and financial decisions.
- **Value:** Better understanding of the diverse values of biodiversity (market and non-market, including cultural and spiritual) across different contexts and sectors, along with a better understanding of biodiversity valuation approaches.
- **Measure:** Improved biodiversity measurement, monitoring and data sharing, with the use of standardised and robust measurement methods, metrics and indicators.

Table E2 shows the the top priority focus areas for targeted biodiversity economics and finance research at the sectoral level.

TABLE E2. The top priority focus areas for targeted biodiversity economics and finance research by sector

Primary production sector	Resources sector	Services sector	Financial sector
1. Learn	**1.** Value	**1.** Economics	**1.** Economics
2. Economics	**2.** Measure	**2.** Account for	**2.** Value
3. Value	**3.** Account for	**3.** Value	**3.** Finance

Next steps

The implementation of this research program will require an effective governance structure and significant resources. A dedicated steering committee will be established to provide the required oversight to facilitate the delivery of this program. A strong alignment with research initiatives underway in Western Australia, other states and at the national level, and with relevant regulatory and policy bodies, will enhance outcomes and reduce the risk of duplicating efforts and resources. To support research driven by end-users, multiple realistic funding options are proposed, including government funding schemes and philanthropy.

We encourage land managers, resource companies, environmental service providers, financial institutions and the research community working in biodiversity economics and finance in Western Australia to share and discuss their interests, management problems, challenges and opportunities with us, and to engage with the delivery of this research program to transform this collaborative work into tangible environmental, social and economic benefits in Western Australia.

Benefits of the research program

Environmental:

- Improved understanding of the state of biodiversity and nature
- Improved availability and better access to biodiversity data
- Greater knowledge of ecological interactions and the environmental impact of conservation actions
- Better conservation and management of biodiversity and nature.

Economic:

- Enhanced understanding of the impact, dependency, risks and opportunities associated with economic activities on biodiversity and nature
- Better understanding of the economic and financial implications of biodiversity loss or nature decline
- Greater knowledge of diverse values of biodiversity and nature in different contexts
- Greater knowledge of biodiversity and nature repair markets, including demand and supply of biodiversity credits or certificates
- Enhanced understanding of effective biodiversity and nature financing products and mechanisms.

Social:

- Enhanced social awareness about biodiversity and nature and human well-being
- Enhanced understanding of cultural and spiritual values of biodiversity and nature, particularly from an Indigenous perspective
- Greater and effective integration of biodiversity and nature considerations into private and public decision-making
- Greater public confidence and trust in biodiversity and nature conservation policy and practice.

1.
Introduction

Nature and biodiversity nurture human well-being. Overexploitation of nature has resulted in the extinction of species and a rapid decline in biodiversity. Globally, there are around one million animal and plant species threatened with extinction (IPBES 2019). Biodiversity loss is considered one of the main environmental challenges of contemporary society.

Nature's decline and biodiversity loss cause collateral damage to society. Socio-culturally, they create a disconnect of local and Indigenous communities from nature. Environmentally, they make the ecosystem more vulnerable by affecting ecosystem functions and processes, thereby negatively impacting the flow of ecosystem services. Economically, the decline of nature and biodiversity loss impact the economic activities of individuals, households and businesses that depend on nature for ecosystem services and raw materials for production. The following examples illustrate the economic value of nature and biodiversity to society:

- An estimated US$58 trillion of economic value generation, equivalent to 55% of global Gross Domestic Product (US$105.6 trillion in 2022$), is moderately or highly dependent on nature and natural ecosystems (Evison et al. 2023).
- About 85% of the world's largest companies listed in the S&P Global 1200 Index are heavily dependent on nature for their direct operations (Whieldon et al. 2023).
- More than half of the market capitalisation listed on 19 of the world's largest stock exchanges is exposed to material nature risk (Evison et al. 2023).

Heavy dependency on nature for economic activities has resulted in over-drawing of nature's provisioning services, which compromises its regulating and maintenance services. Our current demand for nature's products and services exceeds its ability to supply them by 60% (Dasgupta 2021). In other words, society currently needs 0.6 additional Earths to meet its demands from nature. There is an urgency to correct this imbalance and halt the ongoing degradation and decline of nature by repairing and restoring the natural world.

There are various direct (habitat loss and fragmentation, over exploitation, climate change, invasive species and pollution) and indirect (high consumption rate, population growth, economic policies etc.) drivers of biodiversity loss. There is also a growing realisation that biodiversity loss poses an existential threat to human society and carries significant financial risks to businesses and the broader economic system. It is a common concern for the general public, governments, philanthropic organisations, businesses, financial institutions and multinational corporations. It is costly to repair and restore nature and, in some cases, it may be impossible to do so. Similarly, it is also costly to halt biodiversity loss and move towards a nature-positive future, but the available funding is minimal compared to what is needed:

- An estimated US$722–US$967 billion per year funding is needed for biodiversity conservation; however, only about US$124–US$143 billion per year (mostly 80–85% from the public sector) is available, leaving a financing gap of US$598–US$824 billion per year (Deutz et al. 2020).
- The Biodiversity Finance Initiative (BIOFIN)[2] estimates that the current expenditure on biodiversity accounts for only between 0.03% and 0.94% of GDP, or between 0.14% and 4.60% of the entire public budgets, whereas the funding needs for biodiversity conservation are substantially greater (UNDP 2018).
- The Kunming-Montreal Global Biodiversity Framework (KMGBF) estimates a US$700 billion per year biodiversity financing gap to fulfil its targets by 2030 (CBD 2022).

[2] A global partnership managed by the United Nations Development Programme (UNDP) that provides methodologies and strategies for countries to mobilise and manage resources for biodiversity.

Biodiversity economics and finance

Mainstreaming biodiversity into economic and financial decision-making by both the public and private sectors is urgent if we are to bridge the biodiversity financing gap. Bridging the funding gap is key to enabling effective integration of biodiversity into economic and financial decision-making. There is also an urgent need to better understand how biodiversity is linked to or affected by economic activities. To fully understand this link, biodiversity needs to be measured, valued and accounted for at various levels (e.g. species, ecosystem, and landscape or bioregion) across diverse contexts. Understanding this link can help restore, repair and improve biodiversity through sustained stewardship, for which biodiversity finance plays a crucial role. In other words, halting biodiversity loss and improving the state of biodiversity requires financial investment at a scale that matches the scale of the problem.

Biodiversity economics encompasses the economics of the biosphere, including natural capital (Dasgupta 2021). It examines why societies fail to manage biodiversity assets effectively and aims to identify the changes that could improve management practices (Dasgupta 2021).

Biodiversity finance refers to the practice of raising and managing capital and utilising financial and economic incentives to support sustainable biodiversity management (UNDP 2018). It has emerged as a fast-growing area and there is increased interest in financing the transition to nature-smart economic activity from investors, financial institutions and bond issuers globally (IFC 2023).

Additionally, biodiversity and nature should be integral to the decision-making process. Some initiatives have begun in both the public and private sectors to mainstream biodiversity and nature conservation. The United Kingdom's Biodiversity Net Gain law, the European Union's Deforestation Regulation and Australia's Nature Repair Market are some examples of government-led regulatory initiatives. Private sector-led initiatives include the Taskforce on Nature-related Financial Disclosures (TNFD), which has developed guidance to assess the biodiversity impacts and dependencies of businesses, enabling them to identify their risks and opportunities. Similarly, financial institutions (e.g. banks, insurers and investors) have started to assess the sustainability credentials of their investments (NGFS 2023), which affects borrowers (e.g. governments and businesses) in their efforts to secure financing for their business operations. All of these initiatives are geared towards mainstreaming biodiversity into economic and financial decisions. However, for such initiatives to be effective in delivering positive biodiversity outcomes, a range of technical, scientific and policy-related questions surrounding biodiversity economics and finance need to be answered.

Australian and Western Australian contexts

Australia has committed to preventing human-related extinctions by 2030, but its biodiversity is declining at the fastest rate among developed nations. The unique biodiversity of Australia and the country's reliance on nature for economic activities make its nature and biodiversity conservation efforts even more important, as well as challenging. Australia shares similar challenges with the rest of the world in the field of biodiversity economics and finance. The latest state of Australian biodiversity, including the state of biodiversity economics and finance, and the government's initiatives to mainstream biodiversity after the second review of the *Environmental Protection and Biodiversity Conservation Act 1999* (Cwth) (EPBC Act) are summarised on the following page.

State of biodiversity

- The latest State of the Environment report highlights the importance of biodiversity for human survival, well-being and economic prosperity, but alerts us to the worsening situation in Australia (Murphy and van Leeuwen 2021).
  - Australian biodiversity is declining, and the number of threatened species is increasing.
  - Climate change, habitat loss and degradation, and invasive species are the key threats to Australia's biodiversity.
  - Protected areas, recovery efforts and better management of pressures can help to support most threatened species.
- Since 1788, 100 Australian species (38 vascular plants, 34 mammals, 10 invertebrates, nine birds, four frogs, three reptiles, one fish and one protist) are listed as extinct or extinct in the wild under Australian national, state or territory legislation, and under the International Union for the Conservation of Nature (Woinarski et al. 2019).
- About 2,118 Australian species and more than 100 ecological communities are known to be threatened and at risk of extinction (Biodiversity Council 2023).
- Even though 24 priority species showed improvement by 2020, the total number of species listed under the EPBC Act increased for all taxonomic groups since 2016 by an average of 8% (DCCEEW 2022a).
- Scientists have predicted the collapse of 19 Australian ecosystems, including Ningaloo Reef, the Shark Bay seagrass beds and the Mediterranean forests and woodlands in south-west Western Australia, because of climate change and human-induced impacts (Bergstrom et al. 2021).

Biodiversity economics and finance

- Approximately half of Australia's GDP (49.3% or AU$892.8 billion) has a moderate to very high direct dependence on nature or ecosystem services (Pelle et al. 2022).
- Sectors with a very high direct dependence on nature include agriculture, forestry and fisheries (AU$38.7 billion), food manufacturing (AU$23.1 billion), construction (AU$144.4 billion), and waste and water services (AU$19.2 billion), which contribute AU$293.6 billion annually to the Australian economy (about 15.9% of GDP) (Pelle et al. 2022).
- Sectors with a moderate to high direct dependency on nature include mining (AU$127.0 billion), real estate (AU$207.0 billion), transport and logistics (AU$89.6 billion), and accommodation and hospitality (AU$44.3 billion), which contribute AU$602.7 billion to the Australian economy (approximately 33% of GDP) (Pelle et al. 2022).
- Government expenditure on biodiversity and associated administrative functions in Australia has remained at AU$400–500 million annually over the last decade (CBD 2019, ACSI 2021, Legge et al. 2023).
- Annually, Australia spends around AU$122 million on targeted threatened species recovery projects, which is only about 15% of the funding needed to avoid extinctions (Wintle et al. 2019).
- The Blueprint to Repair Australia's Landscapes report suggests an urgent investment need of AU$7.3 billion (i.e. 0.3% of GDP) per year (in 2020$) for 30 years to repair Australia's degraded landscapes (WGCS 2024).
- The value of an Australian biodiversity market is estimated at AU$137 billion in financial flows by 2050, and over 50% of those activities (AU$78 billion) are forecasted to be driven by biodiversity, conservation, and natural capital-themed bonds, loans, debt and equity (PwC 2022a).

Recent government initiatives to mainstream biodiversity and nature

2021

- The second independent review (the Samuel Review) of the EPBC Act
- Threatened Species Strategy 2021–2031
- The State of the Environment Report

2022

- The United Nations Convention on Biological Diversity Kunming-Montreal Global Biodiversity Framework – Australia ratified in November 2022
- The Nature Positive Plan

2023

- The *Nature Repair Act 2023* (Cwth) (established the Nature Repair Market)
- The Nature Repair Act (Consequential Amendments)
- Nature Finance Council
- Australian Government's (Treasury) Green Bond Framework

2024

- Australian Government's Sustainable Finance Roadmap
- Nature Repair Committee
- Australian Accounting Standards Board – Australian Sustainability Reporting Standards
- The first Global Nature Positive Summit
- Australian Sustainable Finance Taxonomy
- *Treasury Laws Amendment (Financial Market Infrastructure and Other Measures) Act 2024*
- Australia's Strategy for Nature 2024-2030 (Australia's NBSAP)

2025

- The Department of Climate Change, Energy, the Environment and Water's National Biodiversity Strategy and Action Plan to the United Nations Convention on Biological Diversity – Australia's Strategy for Nature 2024–2030 Consultation

Western Australia is the largest state or territory in Australia and occupies approximately 32.9% of the nation's land area and 28.2% of its marine area (Geoscience Australia 2014). Its economy is heavily dependent on the goods sector[3] (58%), where mining alone contributes 45% (JTSI 2024a). It is one of the most productive and diversified mineral and petroleum regions in the world and is the leading producer and exporter of Australian minerals, energy and agricultural products.

Western Australia also has unique landscapes and unparalleled biodiversity. It is home to one of the 36 global biodiversity hotspots (South-West land division) and eight[4] of Australia's 15 national biodiversity hotspots (Bailey et al. 2018, DWER 2019). It also has one of the highest rates of endemism on the planet (The Wilderness Society WA 2021).

[3] The service sector contributes 33% and dwelling ownership and others contribute around 9% (JTSI 2024a).

[4] Fitzgerald River Ravensthorpe, Busselton Augusta, Central and Eastern Avon Wheatbelt, Mount Lesueur-Eneabba, Geraldton to Shark Bay Sand Plains, Carnarvon Basin, Hamersley-Pilbara, and North Kimberley.

The threatening processes of biodiversity loss are continuing in the state despite the conservation efforts of government agencies, the private sector and community organisations (Environmental Protection Authority 2007). Additionally, knowledge about many species and ecosystems remains inadequate. The legislative and policy contexts in biodiversity conservation are also changing to achieve better outcomes. The *Biodiversity Conservation Act 2016* (BC Act) and the *Environmental Protection Amendment Act 2020* are relatively recent legislations complementing the *Environmental Protection Act 1986* in the state. These legislations have similar functions to the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) at the Commonwealth level. The recent Native Vegetation Policy for Western Australia outlines a whole-of-government approach to achieve better outcomes for native vegetation and improve clarity and certainty for stakeholders (DWER 2022).

Western Australia has approximately 10,842 known native vascular plants (Florabase 2024), among which 8,952 are endemic (Gallagher 2020). As of June 2024, Western Australia had:

- 250 animal species listed as threatened – 59 critically endangered, 59 endangered and 132 vulnerable – and 23 as extinct under the BC Act (DBCA 2024). Another 114 animal species were specially protected, and 220 species were on the Department of Biodiversity, Conservation and Attraction's priority fauna list
- 444 plant species listed as threatened — 174 critically endangered, 151 endangered and 119 vulnerable — and 16 as extinct under the BC Act (DBCA 2024), with another 3477 taxa on the department's priority flora list
- 65 ecological communities listed as threatened under the BC Act – 20 critically endangered, 17 endangered and 28 vulnerable (DBCA 2024). Another three ecological communities were listed as collapsed and 390 were on the department's priority ecological communities list.

In 2023 Western Australia signed on to Australia's Strategy for Nature 2019–2030, which focuses on six priority areas for national targets (DWER 2024):

- Protecting and conserving 30% of Australia's land and 30% of Australia's oceans by 2030
- Effective restoration of degraded terrestrial, inland water, marine and coastal ecosystems
- Tackling the impact of invasive feral species
- Working towards zero new extinctions
- Minimising the impact of climate change on nature
- Building a circular economy and reducing the impact of plastics on nature.

The Department of Water and Environmental Regulation (DWER) is contributing to establishing the Australian Government's Nature Repair legislation in Western Australia (DWER 2024). A whole-of-government approach to a natural capital valuation framework is currently under discussion in Western Australia to provide guidance on integrating natural capital, including biodiversity, into projects and programs.

Issues and challenges

The main challenges for conservation of biodiversity in Western Australia are linked to climate change, urbanisation, mining and industrial activities, agricultural and livestock production, invasive species, pollution and fire (Department of Environment and Conservation 2006). In addition to these challenges, an important issue related to biodiversity conservation is lack of clarity on biodiversity-related financial risks to business, similar to the financial risks of nature loss (Figure 1).

Specific to biodiversity economics and finance, the following are some of the key issues and challenges (Pandit and Thapa Magar 2024):

- Lack of standardised biodiversity metrics and measurement approaches
- Issues with biodiversity data: quality, accessibility and interoperability
- Challenges in biodiversity valuation, particularly bringing Indigenous approaches for market purposes
- Lack of a holistic framework for natural capital accounting
- Lack of well-developed markets for biodiversity, and inadequate funding and investment in biodiversity
- Lack of innovative financial instruments and policy certainty for long-term investment in biodiversity
- Insufficient financial incentives to attract private investment
- Challenges in scaling up site-specific initiatives to landscape or regional scales
- Uncertainty in risk-reward trade-offs due to the inherent complexity and dynamic nature of biodiversity
- Lack of knowledge and tools to establish a cause-and-effect relationship between biodiversity interventions and ecological and economic outcomes
- Lack of policy certainty and regulatory frameworks
- Lack of tools, frameworks and standards that are relevant to biodiversity economics and finance to help decision-making by different stakeholders (for example, private vs public, or crop farms vs livestock ranches, or retail bank vs insurance company) at different levels.

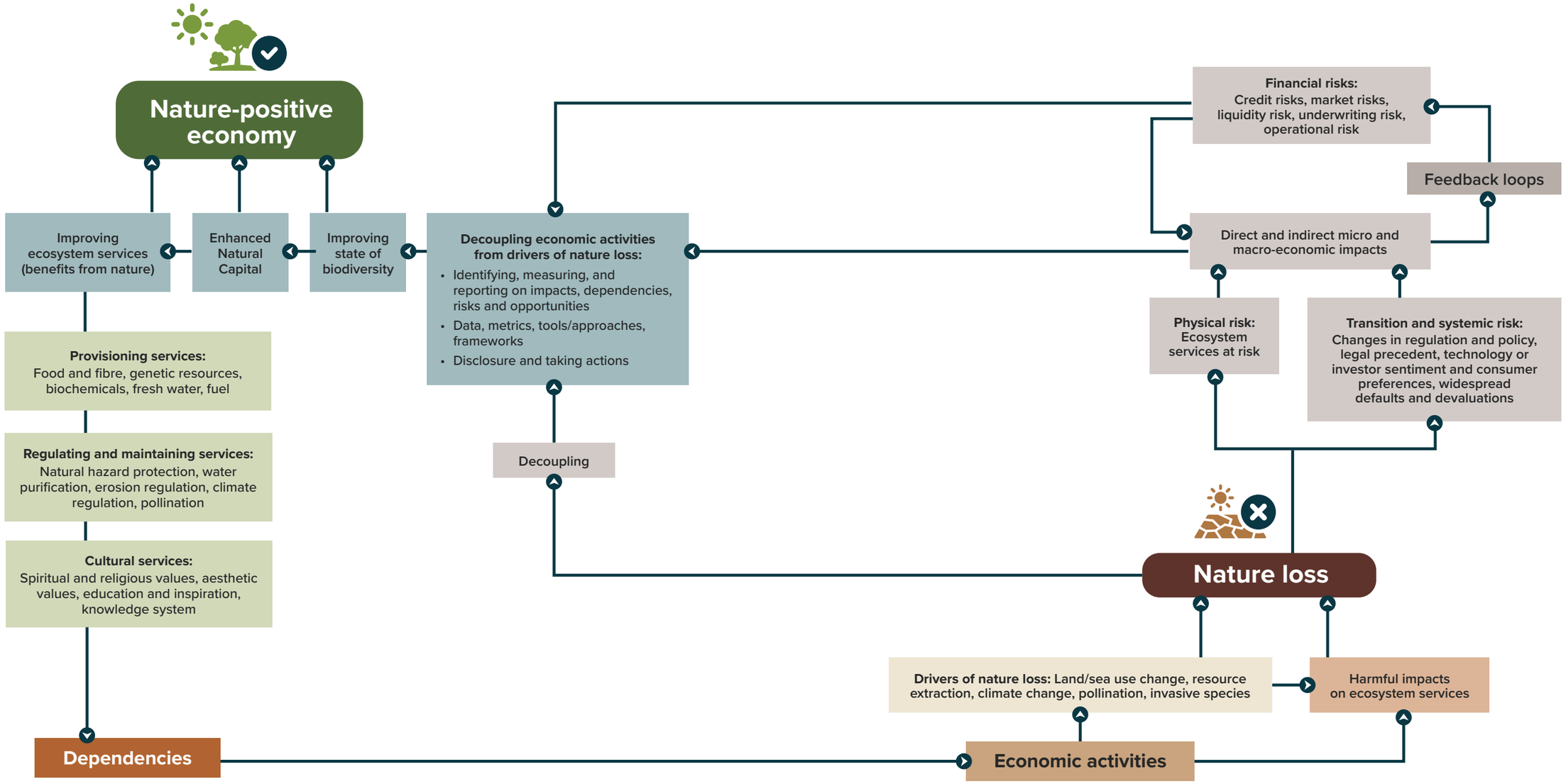


FIGURE 1. Nature and economic activities: dependencies, impacts and financial risks

Source: adapted from ASCI 2021 and other sources listed in Pandit and Thapa Magar 2024, p. 30

2. Program outline

WABSI's Biodiversity Economics and Finance Research Program aligns with the Kunming-Montreal Global Biodiversity Framework (KMGBF) targets (CBD 2022), the Australian Government's Nature Positive Plan (DCCEEW 2022b) and the Western Australian Government's 10-Year Science and Technology Plan (JTSI 2024b).

Specifically, the program aligns well with KMGBF targets 14 (integrate biodiversity in decision-making at every level), 15 (businesses assess, disclose and reduce biodiversity-related risks and negative impacts), 18 (reduce harmful incentives by at least US$500 billion per year, and scale up positive incentives for biodiversity), 19 (mobilise US$200 billion per year for biodiversity from all sources, including US$30 billion through international finance), 20 (strengthen capacity building, technology transfer, and scientific and technical cooperation for biodiversity) and 21 (ensure that knowledge is available and accessible to guide biodiversity action); three aspects of the Nature Positive Plan (nature repair market, better environmental data and environmental economic accounting to value nature); and the Environment and Sustainability pillar of Western Australia's science and technology plan, including its Conservation, Restoration and Discovery research and capability priority.

The research program focuses on building and enhancing the capacity of landholders, conservation managers, policy makers and investment decision-makers to prioritise and develop on-ground strategies for the conservation and management of Western Australia's unique biodiversity by addressing knowledge gap priorities in:

- learning, measuring, valuing and accounting for terrestrial biodiversity
- biodiversity financing, economics and markets
- fostering conditions and policy development that will mainstream biodiversity in public and private decision-making
- biodiversity economics and finance across the primary production, resources, services and financial sectors.

To develop this research program, WABSI adopted a structured approach to identify knowledge gaps and research needs. Extensive stakeholder and end-user consultations were conducted to scope the research program and understand existing issues, problems or challenges in biodiversity economics and finance. Three distinct steps were followed in developing the research program: a) literature review, b) expert and stakeholder consultations, and c) end-user and stakeholder workshops.

The literature review (Pandit and Thapa Magar 2024) helped to scope the research program in global, national and local contexts. In particular, it facilitated an understanding of contemporary issues, problems, challenges, knowledge gaps and research needs in biodiversity economics and finance.

The expert and stakeholder consultations involved two specific groups: researchers (who generate the knowledge) and knowledge end-users (who use the generated knowledge in their business or work). This consultation helped identify issues, challenges and problems in biodiversity economics and finance from their perspectives. Consultations were focused on issues and challenges related to learning, measuring, valuing and accounting for biodiversity and nature. Additional focus was placed on biodiversity finance, markets and economics, as well as policy setting and practices to mainstream biodiversity and nature. Government officials, industry professionals, finance and environmental service providers, academics and researchers, Indigenous knowledge holders and First Nations scholars, as well as end-users of knowledge products (such as Natural Resource Management (NRM) organisations, farmer or grower groups and resource companies) were consulted during this phase.

Finally, two types of workshops – issue identification and research prioritisation – were organised with stakeholders and end-users. First, four issue identification workshops were organised, each with a focus on a specific sector: primary production, resources, services (research and consulting) and financial. Second, two research prioritisation workshops, one face-to-face and one online, were organised to collectively prioritise the overarching research needs across and within each sector.

The findings of the consultations and issue identification workshops were qualitatively analysed to identify major knowledge gaps and research questions. The research prioritisation workshops helped develop an overarching, prioritised research program consisting of themes, focus areas, knowledge gaps and research questions. The research program also outlines sectoral research priorities set by respective end-users and stakeholders during the prioritisation workshops, which provides a sector-specific research program.

During the qualitative analysis of stakeholder consultations and workshop findings, a research program framework also emerged, comprising two themes and nine focus areas. Each focus area has several knowledge gaps, and each knowledge gap comprises multiple research questions. The two research themes in biodiversity economics and finance are Understanding and Mainstreaming biodiversity and nature. The nine research focus areas are Learn, Measure, Value, Account for, Enabler, Economics, Market, Finance and Practice. The first four focus areas are primarily associated with the Understanding theme, while the latter five focus areas are associated with the Mainstreaming theme.

The program is a collaborative effort between multiple stakeholders and knowledge end-users of biodiversity science in Western Australia. The key stakeholders of this program are state government departments (mainly the Department of Biodiversity, Conservation and Attractions (DBCA), Department of Water and Environmental Regulation (DWER), Department of Primary Industries and Regional Development (DPIRD), Department of Planning, Lands and Heritage (DPLH), Department of Treasury and the Western Australian Treasury Corporation (WATC)), the resources industry, researchers and research organisations (e.g. universities and the CSIRO), environmental service providers, farmers and landholders, non-governmental organisations, NRM organisations, Indigenous communities and institutions, funders and financial institutions (banks, insurance companies, asset management companies and financial consulting firms). Other stakeholders include those from other sectors of the economy, such as infrastructure development, that are directly and indirectly linked to biodiversity and nature.

Complex research questions require collaboration, and an advisory board or steering committee will be established to help implement the program as a joint effort between stakeholders, governments, funders, Indigenous groups and research organisations. The program will contribute to the Western Australian Science and Technology Plan 2025–2035 under its Environment and Sustainability pillar. Ultimately, answering the priority research questions outlined in the program will generate research evidence for understanding and mainstreaming nature and biodiversity into economic and financial decision-making, which will benefit Western Australian people, businesses and nature.

Vision

The vision of this research program is to address the priority knowledge gaps in biodiversity economics and finance for Western Australia with integrated and coordinated new research. This will enable the translation of the research insights into practical and operational outcomes that will benefit nature, culture, people and the economy (i.e. communities, landholders, industries, financial service providers and governments) by integrating biodiversity and nature into decision-making at all levels.

Objectives

The primary objective of this research program is to provide a prioritised research framework to address knowledge gaps and research questions in biodiversity economics and finance for Western Australia. It does so by developing a clear pathway from knowledge gap identification to research prioritisation, funding, and implementation approaches to achieve improved outcomes for stakeholders and knowledge end-users. Specific objectives are to:

- provide an innovative research program in biodiversity economics and finance for Western Australia based on its unique biodiversity and landscapes, which will facilitate the mainstreaming of biodiversity into economic and financial decision-making
- articulate clear pathways from learning to practice in biodiversity economics and finance for improved outcomes (for the environment, community and industry) within and across key sectors in Western Australia.

Outcomes

The outcome of the research program is to address the priority knowledge gaps in biodiversity economics and finance with relevant research. This will scale up and improve the process and practice of research end-users in Western Australia.

The specific outcomes are:

- improved understanding of measuring, valuing and accounting for biodiversity and nature among landholders, industries, financial institutions and other key stakeholders
- improved understanding of business impact, dependency, risks and opportunities associated with biodiversity for various economic sectors
- improved understanding of biodiversity values (instrumental, intrinsic, relational; or economic, socio-cultural, spiritual)
- testing or adapting tools and frameworks in measuring, valuing and accounting for biodiversity
- better understanding of and engagement with the biodiversity market, including demand and supply of biodiversity certificates or credits
- improved understanding and development of financial models and instruments to generate resources for biodiversity financing
- identification of areas for policy interventions to improve biodiversity outcomes for Western Australia.

3.

Benefits to stakeholders

There are multiple stakeholders who benefit from this research program in various ways. The key stakeholders and main benefits of the research program are as follows.

Stakeholders

- Researchers and research organisations
- Local, state and the Australian governments
- Natural Resource Management (NRM) organisations
- Conservation policy think tanks
- Non-government conservation organisations
- Indigenous landowners and managers – Aboriginal corporations, ranger groups
- Environmental consultants and consulting firms
- Financial service providers – consultants, accounting firms
- Financial sector – Treasury, banks, insurance companies, asset management firms
- Resources sector
- Primary production sector – agriculture and forestry
- Communities and individuals

Economic value

Currently there is no available research that shows the economic value of Western Australia's biodiversity. Given the state's rich and unique biodiversity, the following biodiversity-related value estimates provide some indication of the economic importance of its biodiversity.

- Western Australia's biodiversity has multiple economic values: direct-use, indirect-use, bequest and existence value.
- The direct use value of biodiversity (financial flows to biodiversity) is estimated at AU$137 billion by 2050, i.e. the biodiversity market could unlock massive financial flows to advance Australian biodiversity outcomes by 2050 (PwC 2022a).
- About AU$78 billion (56.9% of AU$137 billion) is forecasted to be driven by biodiversity, conservation and natural capital-themed bonds, loans, debt and equity.
- The cost of investing in discovery and documentation of all remaining Australian species within a generation is estimated at AU$824 million, and the benefits of doing so are estimated at the range of AU$3.7 billion to AU$28.9 billion in 2020$ (assuming 4% discount rate for the period of 25 years from 2020 to 2045) (Deloitte 2021).
- Investing AU$1 to discover and document a species would generate benefits at a range of AU$4 to AU$35 to Australia (Deloitte 2021).
- Spending of €1 (one Euro) on the Global Biodiversity Information Facility, an international government-funded organisation that provides open source data about life on Earth, could result in benefits ranging from €3 to €12 (Deloitte, 2023).
- About 75% of the world's food crops rely on animal pollinators for yields, and these crops contribute 35% of global crop volume, representing an estimated market value of AU$350 to AU$860 billion (Klein et al. 2007, IPBES 2016).

Environmental, health and social benefits

Biodiversity and nature generate a range of environmental, health and social benefits, which are important for human society. Here are some examples of such benefits.

- Exposure to nature improves psychological health, including increased happiness and self-worth and less severe mental health disorders, such as anxiety and depression (Barraclough et al. 2023). In all of these, biodiversity plays a role.
- Indigenous people place great cultural and spiritual value on native species and ecosystems. Consequently, biodiversity loss results in a loss of their culture and identity (Cresswell et al. 2021).
- Biodiversity acts as a natural pharmacy, and drug discovery from wild species will continue to be critical for health care, wellness and disease prevention (Cresswell et al. 2021). For example, angiotensin-converting enzyme inhibitors were derived from Brazilian pit viper venom, and the venom of Australia's eastern brown snake is a component of a newly developed innovative gel that acts as a haemostatic wound sealant (Patlak 2004, Yegappan et al. 2022).
- About 90% of wild flowering plants depend on pollinators (IPBES 2016).

The cost of inaction

Biodiversity has a central role in generating flows of ecosystem services, which are inputs to households and firms across different sectors of the economy. If ecosystem services are lost due to inaction, significant costs are borne by households, firms and the economy. The cost of inaction on biodiversity loss is high.

- The estimated annual loss from the collapse of ecosystem services, in which biodiversity plays an integral part, is US$2.7 trillion by 2030 (Johnson et al. 2021).
- Approximately 22% (AU$260.79 billion) of all outstanding lending finance in Australia accounts for the four sectors – agriculture, property, resources and energy (EY 2023) – which have high dependency and impact on biodiversity and nature. Not taking actions to integrate nature or biodiversity into financial decisions would generate material financial risks to these four sectors (EY 2023).
- Loans and underwriting services provided by the world's largest 50 banks was estimated at US$2.6 trillion in 2019, which was invested in the sectors that are the primary drivers of nature loss (Deutz et al. 2020).

4.

Program development

The program development process

WABSI followed a research program development pathway (Figure 2) to develop the Biodiversity Economics and Finance Research Program. The pathway follows an iterative process that engages knowledge end-users, stakeholders and researchers.

The end-users and stakeholders help scope, define and set the research priorities following the program development pathway, which also allows ongoing engagement between end-users and research experts through a series of workshops to refine the program scope and priorities.

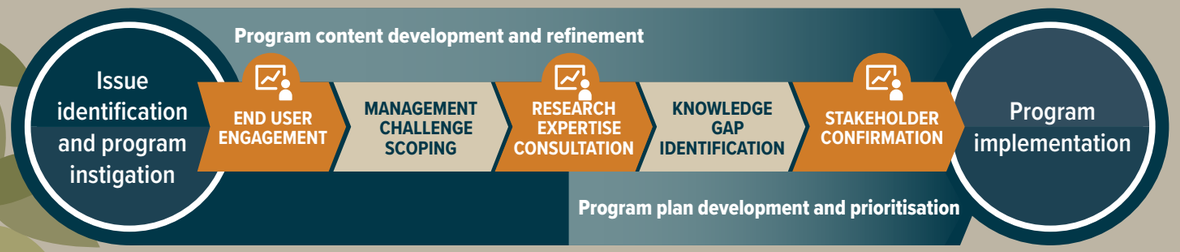


FIGURE 2. The WABSI research program development pathway

The findings from consultations and workshops are refined, analysed and summarised to screen them using WABSI's research challenge screening framework (Figure 3). These knowledge gaps or research challenges can be grouped into one or more of the framework components: research, funding, communications, policy and management. The primary role of WABSI is to enable better biodiversity outcomes by addressing knowledge gaps and research challenges where research interacts with or overlaps the other four components of the screening framework.

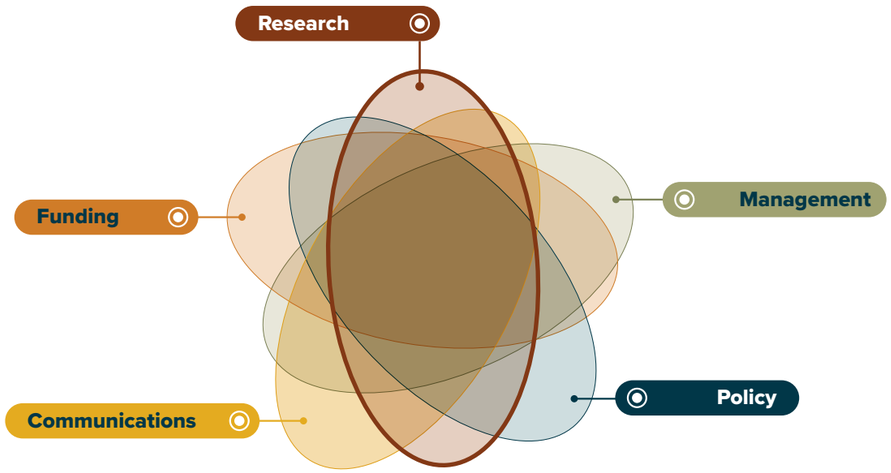


FIGURE 3. The WABSI's research challenge screening framework for the Biodiversity Economics and Finance Research Program

Program consultations and workshops

Consultations

An extensive consultative process was adopted to scope the research program in biodiversity economics and finance for Western Australia. The consultation was conducted with a broad range of stakeholders and end-users within Western Australia, nationally and internationally. The key stakeholders and end-users consulted were research experts, government officials and departments, industry representatives and industry bodies, environmental professionals, financial service providers, community organisations, and First Nations scholars and communities.

End-user and stakeholder consultations were undertaken between March and August 2024 as face-to-face and online meetings. A total of 75 experts, end-users and key stakeholders were consulted to understand their perspectives on biodiversity economics and finance (Appendix 1). The objective of the consultations was to understand key issues, problems and challenges related to the understanding and mainstreaming of biodiversity, and to identify general or Western Australia-specific knowledge gaps, research needs and future challenges that require answers through collaborative research.

The composition of consulted experts, stakeholders and end-users by geographic location and by stakeholder or end-user sector is presented in Figure 4 (a and b).

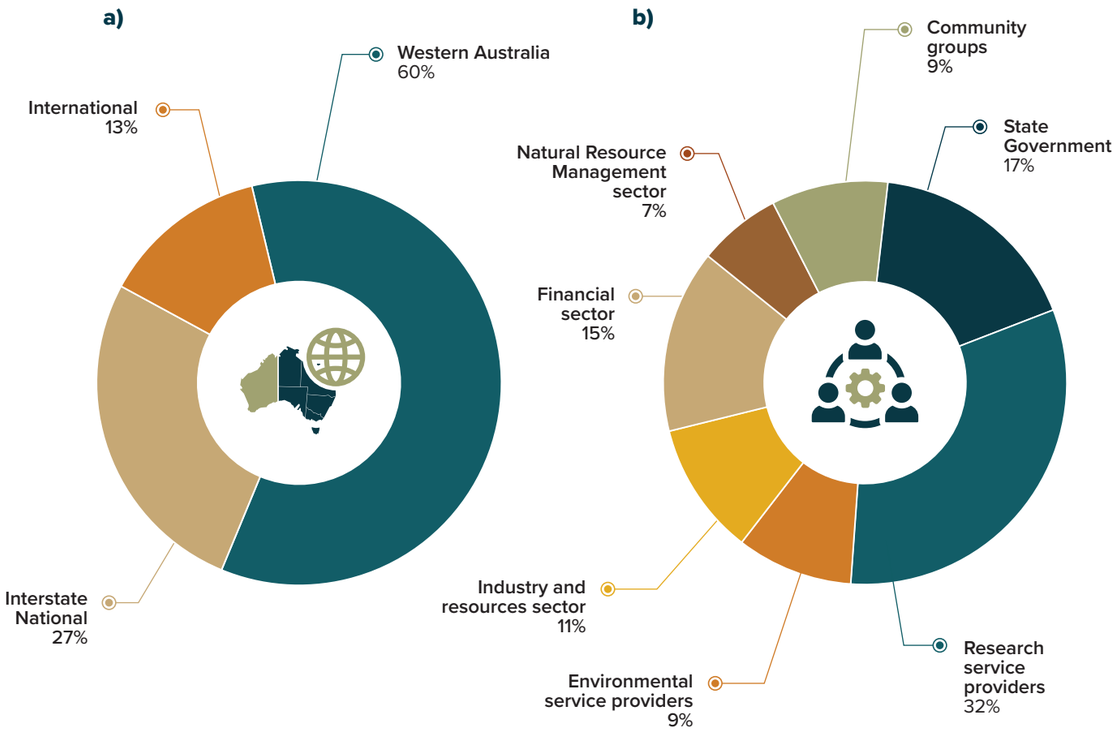


FIGURE 4. Composition of the consulted experts, stakeholders and end-users by a) geographic location and b) sector

Outcomes of consultations

Summary outcomes identifying the main issues, problems and challenges in biodiversity economics and finance are provided in Box 1.

BOX 1. Summary of the main issues, problems and challenges in biodiversity economics and finance

1. Lack of clarity and a non-uniform approach to accounting for natural capital

- Lack of established links between the stock and flow of ecosystem services
- Lack of a consistent approach to natural capital accounting
- Lack of knowledge on how to connect across different natural capital accounting frameworks.

2. Lack of robust and consistent methodologies for biodiversity measurement

- Need for biodiversity data in both physical and monetary terms
- Lack of location-specific and granular biodiversity data
- Lack of cost-effective, easy-to-apply, universal and robust biodiversity metrics.

3. Challenges in valuing biodiversity and natural capital

- Lack of a good understanding of instrumental, intrinsic and relational, or economic and socio-cultural values of biodiversity, particularly from an Indigenous perspective
- Need for cost-effective ways to value biodiversity and nature
- Difficulty in monetising biodiversity and nature for market purposes.

4. Uncertainty and a lack of clarity in the design and functioning of biodiversity markets

- Lack of consensus on metrics for voluntary biodiversity markets
- Uncertainty about the extent of private sector demand for biodiversity credits or certificates
- Need to develop robust and trustworthy biodiversity credit methodologies
- Need to enhance the value proposition for investors to participate in biodiversity markets.

5. Challenges in integrating biodiversity considerations into decision-making processes across various sectors and scales

- Lack of industry-specific decision-making tools and frameworks
- Difficulties in understanding the evidence needed by policymakers
- Mixture of barriers and opportunities to integrate biodiversity into corporate decision-making.

6. Need for a holistic framework for biodiversity and nature valuation that can connect people, the planet and prosperity (businesses)

- How to address challenges in moving beyond purely economic considerations to encompass broader societal and environmental values of biodiversity and nature.

7. Issues in the scalability of biodiversity measurement and accounting

- Need to develop consistent frameworks for different landscapes to account for biodiversity
- How to scale up biodiversity measurement from a single site to an ecosystem level is a key challenge.

8. Lack of clarity and coherence in the process of verifying ESG (environmental, social and governance) credentials by businesses

- Need for an operational framework to integrate ESG into investment decisions for different sectors and businesses.

9. Lack of understanding of the complex interactions and dynamics of biodiversity and natural capital

- Need to understand the links between different forms of natural capital (e.g. soil, water and biodiversity)
- Need to understand the cause-and-effect relationships of interventions or actions on biodiversity outcomes (response function)
- Need to understand the cumulative impacts of economic activities on biodiversity and nature.

10. Lack of enabling policy frameworks and clear guidance on how to integrate biodiversity and nature into business decisions

- Need for a coordinated whole-of-government approach and policy certainty for biodiversity investments
- Need for the development of enforcement and governance mechanisms for biodiversity markets
- Need to resolve land tenure and land use issues to integrate biodiversity and nature into business decisions.

11. Lack of clarity on biodiversity financing mechanisms

- Who will finance biodiversity conservation and at what costs?
- Limited public funding
- Need to understand private sector motivations to invest in biodiversity and nature
- Lack of clarity in financial reward mechanisms for those investing in biodiversity.

WORKSHOP 1 Issues identification

The consultation process with end-users and key stakeholders helped to scope the program workshops. Based on consultations, a sectoral approach was adopted to identify the key issues, problems and challenges in biodiversity economics and finance for Western Australia. Four issue identification workshops were undertaken in November 2024 for the primary production, resources, services (research and environmental) and financial sectors. A synopsis of the workshops is presented in Table 1. Separate meetings were organised with additional key stakeholders who were unable to join the workshops to understand their perspectives on key issues and challenges (e.g. the Grower Group Alliance).

A total of 58 individuals participated in these workshops. A list of participants and their organisations is available in Appendix 2a. Details of the workshop discussion on issues, problems and challenges in biodiversity economics and finance are presented in Appendix 3 by sector (A-3 Box 1 to A-3 Box 4).

TABLE 1. A synopsis of issues identification workshops

Sector	Date	No. of participants	Participants/organisations
Primary production sector	18 November 2024	12	Landholders, NRM groups, grower groups, Greening Australia, DPIRD
Resources sector	19 November 2024	16	Resource companies, DBCA, DWER
Services sector	21 November 2024	16	Environmental consultants, university researchers, DWER, CCWA
Financial sector	22 November 2024	14	WA Treasury, WATC, financial institutions, consulting firms

WORKSHOP 1 Outcomes

The identified issues, problems and challenges in biodiversity economics and finance through consultations and workshops were qualitatively synthesised to identify the key overarching (Box 2) and sectoral (Boxes 3 to 6) knowledge gaps or research needs.

All identified knowledge gaps were further analysed by using WABSI's research screening framework in two ways: first, collectively for overall knowledge gaps based on consultation and workshop findings, and second, individually for each sectoral workshop.

During the analysis, a research program framework was also developed that helped organise the knowledge gaps into themes and focus areas. The framework helped to develop a coherent research program. The details of the research program framework is described in the 'Research program framework' section.

Based on the overall analysis, key knowledge gaps or research needs are presented in Appendix 4. Similarly, the key sectoral knowledge gaps are presented in Appendices 5a to 5d for the primary production, resources, services and financial sectors, respectively. These knowledge gaps or workshop outcomes are presented by research focus area as they interact with WABSI's research screening framework.

The workshop outcomes that are within the domain of research were taken into the prioritisation phase following WABSI's program development pathway.

BOX 2. Overarching summary of knowledge gaps or knowledge needs

- Establish baseline or reference level of biodiversity for different ecosystems and consistently monitor changes over time.
- Develop standardised and consistent methodologies to measure biodiversity across different levels (species, ecosystem), scales (site, bio-region) and sectors (primary production, resources etc.).
- Conduct valuation of biodiversity, including both monetary and non-monetary values, using measures that facilitate holistic decision-making.
- Understand relational values of biodiversity, i.e. cultural and spiritual values, from Indigenous perspectives and integrate them into land use decisions.
- Identify, assess and adapt the effective Indigenous knowledge-based practices to conserve biodiversity.
- Develop cost-effective technologies and methods to gather granular biodiversity data across land use types, sectors and ecosystems.
- Develop and advance natural capital accounting approaches (frameworks, tools, guidance) to integrate biodiversity and nature's services into economic modelling and policy decisions.
- Assess the supply and demand sides of emerging biodiversity markets, including biodiversity credits or certificates.
- Understand and identify the biodiversity risk appetite of businesses, government agencies and financial systems, and develop robust biodiversity risk management frameworks.
- Identify effective financial mechanisms and incentives to encourage private sector investment in biodiversity conservation and the development of biodiversity and natural capital markets.
- Understand the economic and social benefits of investing in biodiversity and natural capital, including the cost of inaction.

BOX 3. Summary of key knowledge gaps: Primary production sector

- Clearly define and quantify what growers or farmers can realistically achieve from biodiversity and/or natural capital on their farms. This includes understanding the potential benefits and practical outcomes of biodiversity-friendly practices.
- Provide practical guidance on how to integrate biodiversity into existing farming practices effectively. Landholders need clear, actionable steps and strategies tailored to their specific contexts.
- How to value the outcomes of ecological restoration in agricultural terms, i.e. relative to traditional agricultural outputs. Bridge the gap between ecological restoration and agricultural productivity metrics.
- Develop standardised and consistent approaches to measure biodiversity at species and ecosystem levels that are relevant and practical for the primary production sector. This includes determining what metrics are most useful and feasible for on-farm application.
- Quantify the extent of dependency of different primary production sectors (e.g. agriculture, livestock, horticulture) on various components of biodiversity and natural capital. Understanding these dependencies is crucial for highlighting the value of biodiversity.
- Understand the link between biodiversity or natural capital investments and improved health and productivity outcomes at a regional scale (e.g. reduced health costs, green jobs) in the primary production sector. Quantifying the health link can strengthen the case for investing in biodiversity.
- Develop tools or frameworks to forecast biodiversity outcomes of development actions and to value biodiversity in multi-functional or multi-objective landscapes. Develop models that can predict the impacts of different land management practices on biodiversity outcomes (response function).
- Understand how to value biodiversity in the context of the government's shift towards restoration and carbon/ecosystem service markets. This includes developing (common or consistent) approaches for natural capital accounting in the primary production sector.
- Need for research to determine the cost-efficiency or economic implications for farmers to adopt biodiversity-focused agricultural (or other) practices.
- Conduct market analysis to understand the supply and demand-side factors of biodiversity credits and to develop a viable biodiversity credit trading scheme for Western Australia. This includes identifying what is demanded, what can be supplied, what to trade at what price, and the associated trade-offs.

BOX 4. Summary of key knowledge gaps: Resources sector

- Develop climate-smart conservation approaches, i.e. how biodiversity conservation strategies can be adapted to address the challenges of climate change. Identify effective methods for integrating climate change projections into conservation planning.
- Develop well-defined but flexible approaches for biodiversity measurement. Standardise biodiversity measurement methods that account for uncertainty or variation at appropriate scales (e.g. bio-region).
- Identify the most critical gaps in biodiversity data and find ways to address these data gaps. Need for targeted research efforts to improve our understanding of (existing or future need) biodiversity data.
- Develop frameworks or tools to integrate biodiversity considerations effectively into environmental impact assessment and other decision-making processes in line with emerging environmental laws and policies.
- Develop standardised metrics to measure biodiversity across different ecosystems. This is essential for consistent accounting, measurement and assessment of biodiversity impacts in the resources sector.
- Identify the most effective approaches to value biodiversity in monetary terms for decision-making. This will help make a stronger economic case for biodiversity conservation.
- Develop frameworks and tools for natural capital accounting for the sector with a particular emphasis on biodiversity impacts and dependencies, as well as opportunities and risks.
- Understand and assess the demand for biodiversity credits. Develop a viable market-based mechanism for biodiversity conservation in the resources sector.
- Consolidate existing biodiversity research to create a robust evidence base for decision-making within the resources sector. This suggests that while data exists, there's a need to synthesise it into actionable knowledge for the industry.
- Identify biodiverse restoration techniques, especially considering the changing climate. This highlights a gap in understanding in how to restore biodiversity and ecosystems in the face of climate change.
- Improve the effectiveness of restoration projects, particularly in areas where ecological knowledge is limited. This suggests a need for more applied ecological research to inform restoration practices.

BOX 5. Summary of key knowledge gaps: Services sector

- Understand effective ways to connect the public with biodiversity and nature to increase conservation awareness and actions.
- Create and maintain accurate and reliable biodiversity data for analyses, reporting, and the development of biodiversity-related services.
- Establish or determine the true baseline for biodiversity. This is crucial for evaluating the effectiveness of interventions and assessing their long-term ecological impacts.
- Quantify the value of urban biodiversity and the impacts of biodiversity loss in cities.
- How to quantify the intrinsic and relational values of biodiversity and nature's services, such as cultural or spiritual values, and find ways to integrate them into decision-making.
- Determine how to reconcile observational data with inferred decision-making processes.
- Develop a consistent approach or framework to value biodiversity. This would help financial institutions and others to provide more standardised and comparable products and results.
- Quantify the cost of inaction, i.e. not protecting biodiversity, in terms of the value of lost nature's services (e.g. pollination services). This information is helpful in risk assessment, insurance and economic modelling to demonstrate the economic rationale for biodiversity conservation.
- How to capture Indigenous and local knowledge in the natural capital accounting process. This is crucial in implementing natural capital accounting to ensure that cultural and social perspectives are included, leading to more effective and equitable biodiversity management.
- How to improve biodiversity assessment (consistency and quality of biodiversity data) using new techniques such as eDNA. This would enable service providers, such as environmental consultants, to offer more efficient and potentially more accurate biodiversity assessments.

BOX 6. Summary of key knowledge gaps: Financial sector

- Develop robust and cost-effective methodologies to accurately measure biodiversity, establish clear and independent baselines, and track changes over time.
- Clarify new concepts in operational terms for the financial market, such as 'no net loss' and 'net gain'.
- Enhance understanding of ecosystem tipping points and develop frameworks to integrate these critical thresholds into financial and economic decisions.
- Develop cost-effective and practical approaches to value biodiversity.
- Develop methods for pricing nature-related risks for businesses and integrate these risks into economic modelling (i.e. internalise environmental costs in financial decisions).
- Quantify the financial implications of biodiversity loss (or demonstrate the economic benefits of conservation) to the financial sector.
- Understand and clearly define the government's risk appetite for biodiversity loss.
- Design and evaluate government policies and financial incentives that are aligned with the needs of the private sector to encourage biodiversity conservation, promote risk sharing, and ensure coherence between immediate economic goals and long-term sustainability objectives.
- Develop unified frameworks and approaches to understand and manage biodiversity risks by corporate (business) and government agencies, which can help to mitigate regulatory, reputational and financial risks associated with biodiversity loss.
- Develop robust and transparent mechanisms to ensure the effectiveness of biodiversity offsets, which address concerns related to future tenure security and potential fraud.
- Explore and develop new and innovative financing models for biodiversity conservation, such as green bonds and biodiversity credits, to create sustainable and long-term funding mechanisms.
- Understand and explore the potential of using biodiversity data or reporting requirements for social licence and reputational benefits to drive biodiversity investment.

WORKSHOP 2 Research prioritisation

Based on the outcomes of the consultations, issue identification workshops and the application of WABSI's research screening framework, a research prioritisation document was developed. It consists of the program's vision, objectives and outcomes, and follows the program development framework described in the 'Research program framework' section. The framework consists of nine research focus areas grouped into two themes – understanding and mainstreaming. For each focus area, knowledge gaps were analysed and presented alongside research objectives, expected outcomes and sample research questions. The framework enabled prioritisation of research focus areas and knowledge gaps by workshop participants.

Two research prioritisation workshops were held in June 2025 as shown in Table 2. Appendix 2b lists the workshop participants and their participation mode. During the research prioritisation workshops, participants ranked the nine research focus areas and knowledge gaps associated with each focus area for overall program-level priority as well as for four sectoral priorities. For sectoral prioritisation, in-person workshop participants were grouped into the most relevant sector to their experience and background. The inputs from online participants were incorporated into the inputs provided by the in-person participants (see Table 2, Remarks).

In addition, feedback from WABSI Board Directors, members of the Collaboration, Leverage and Integration Committee and key stakeholders (researchers and government departments) was sought to align and ascertain the biodiversity economics and finance research priorities. The insights gained from Indigenous scholars (Appendix 2c) on knowledge gaps and research needs are also embedded in the prioritised research program.

TABLE 2. Research prioritisation workshops

Date	Mode	No. of participants	Remarks
12 June 2025	In-person	21	Research prioritisation for focus areas and knowledge gaps within each focus area was conducted among four mixed groups for overall prioritisation and across four sectoral groups for sector-specific prioritisation.
13 June 2025	Online	11	The group consisted of diverse stakeholders from various sectors. Prioritisation was done for some aspects of the program, but not for all, which was complemented by the individual responses received afterwards.

WORKSHOP 2 Outcomes

In line with the program development framework described in the 'Research program framework' section, the findings of the research prioritisation workshops are summarised on the following page.

Ranking focus areas: Overall program and by sector

The ranking outcomes for the focus areas are presented for overall and sectoral priorities (Figure 5). Overall priority is set based on group averages (four groups based on in-person workshops, and two responses received from online participants after the online workshop). Sectoral priorities are based solely on a face-to-face workshop. For overall program-level priority, the prioritisation results indicate that the three top-ranked research focus areas are Economics, Value and Measure.

Among the sectors, most research focus areas are prioritised in a similar way to the overall priority (Figure 5). For example, the research focus area of Value is highly prioritised, whereas Practice is least prioritised across all the sectors. However, some focus areas are prioritised differently by sector. The focus area of Economics is considered a top priority for the primary production, services and financial sectors, but not for the resources sector. However, the focus area of Measure is regarded as one of the top priorities. The focus area of Finance is regarded as a top priority for the financial sector, but not for others. Contrastingly, the focus area of Learn is ranked as the top priority for the primary production sector.

The prioritised Biodiversity Economics and Finance Research Program is presented below for each theme and focus area. For the overall program, the research focus areas (Figure 5) and the knowledge gaps in each of them were ranked to contribute to the program vision, and to achieve program objectives and outcomes. **Part A** presents the program level or overall ranking of key knowledge gaps by research theme and focus area, along with example research questions (Tables 3–11). In presenting the overall program-level knowledge gaps, alignment of these gaps with other WABSI research programs was also indicated.

Part B presents the sectoral ranking of key knowledge gaps by focus area, with example research questions: Tables 12–20 for the primary production sector, Tables 21–29 for the resources sector, Tables 30–38 for the services sector, and Tables 39–47 for the financial sector.

Theme	Focus area	Overall priority	Sectoral priority			
			Primary production	Resources	Services	Financial
Understanding	Learn	5	1	9	9	5
	Measure	3	4	2	4	4
	Value	2	3	1	3	2
	Account for	4	7	3	2	7
Mainstreaming	Enabler	7	6	6	8	6
	Economics	1	2	5	1	1
	Market	8	8	7	6	8
	Finance	6	5	4	5	3
	Practice	9	9	8	7	9

FIGURE 5. Ranking of focus areas for overall and sectoral priorities (the darker the shade of green, the higher the priority, the darker the colour ochre, the lower the priority. Number 1 represents the highest priority whereas 9 represents the least priority.)

Part A: Program-level ranking: Ranking of overall knowledge gaps by focus area

THEME 1 **Understanding**

Rationale

Biodiversity economics and finance is a relatively new field of research. Some fundamental understandings are required to advance this research field in Western Australia. The research program framework highlights four focus areas within the theme of Understanding that are crucial for biodiversity economics and finance research. These focus areas are Learn, Measure, Value and Account for. The outcome, objectives, knowledge gaps and their ranking, along with example research questions, are presented next.

Focus area 1: Learn

Learn focuses on raising awareness of the concepts, importance, and state of biodiversity and nature's services. It involves understanding some basic concepts and questions relevant to biodiversity economics and finance.

TABLE 3. Learn: Outcome, objectives, knowledge gaps and their ranking, and example research questions

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
The research end-users and key stakeholders would have understood clearly the link between biodiversity and businesses, and be able to articulate the need to integrate biodiversity into (land use or business) decisions.	• Understand the link between biodiversity and businesses (across sectors). • Develop clarity on emerging concepts of biodiversity economics and finance. • Understand land use interventions, ecological interactions and their economic implications.	Link between state of biodiversity and business performance (financial outcomes)[#]	3	• What are the site-specific biodiversity risks that are associated with corporate-level business risks? • What are the biodiversity risk profiles of private sector corporations or businesses? • How to improve the understanding of businesses about the attribution of biodiversity outcomes (i.e. how to know what actions contribute to which results)?
		Practical guidance to integrate biodiversity into land management decisions[^]	4	• What are the practical guidelines for landholders (farmers, pastoralists) on what they can achieve from natural capital and biodiversity in their farms? • What do landholders know about farm activities and their interactions with the surrounding environment (and vice versa) in terms of economic outputs? • What is known about the relationship between the stock of biodiversity (nature) and farm productivity? • What do farmers need for scalable and robust evidence?
		Meaning and practical implications of key concepts	2	• What do concepts like 'no net loss' and 'net gain' mean for financial markets? • What are the trading units for biodiversity markets? • What does the concept of counterfactual mean in biodiversity assessments for various businesses and contexts?
		Link between activities, ecological interactions and resultant biodiversity outcomes[#,^]	1	• How are land use activities, ecological interactions and economic–ecological outputs connected? • What is known about the cause-effect relationship (response function) of any land use actions and the resultant biodiversity outcomes in the farming context? • How does the cumulative (landscape-level) effect operate and become apparent in the actions at Site A on the outcomes at Site B and vice versa? • What do we know about the extent and nature of cumulative impact of individual decisions on biodiversity at landscape level (for example, in the case of mining in the Pilbara)?
		Stakeholders' motivations and information needs for biodiversity	5	• What motivates stakeholders (government, regulators, industry, financial institutions, communities) to invest in biodiversity and nature? • What are the value propositions of landholders to engage in natural capital accounting or biodiversity markets? • What are the biodiversity-related information needs of knowledge end-users and how do they use that information?

Note: These knowledge gaps are aligned with other WABSI research programs: # Restoration Economy, ^ Data and Information Management

Focus area 2: Measure

Measure assesses the state of biodiversity and nature based on data, methods and measurement metrics. It is about understanding the state of biodiversity and associated challenges.

TABLE 4. Measure: Outcome, objectives, knowledge gaps and their ranking, and example research questions

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
There is improved biodiversity measurement, monitoring and data sharing with the use of standardised and robust measurement methods, metrics and indicators.	• Develop fit-for-purpose biodiversity measurement methods and data metrics for different land use and business contexts. • Develop frameworks and guidance to improve biodiversity measurement. • Develop insights from new and existing biodiversity data to support decision-making.	Biodiversity data bank and access to existing data^	2	• What are the reference levels and/or baseline data to monitor changes in biodiversity? • How to develop a system of data repository from existing but fragmented data? • How to provide access to existing biodiversity data in an interoperable way? • How to improve the quality of biodiversity data?
		Biodiversity data and measurement needs#,^,*	4	• How to measure variability and ecosystem interactions? • What are the biodiversity data requirements for decision-making (what data, in what form and for what purpose)? • What level of granularity is needed in biodiversity data for a given purpose (biological – gene, species, ecosystem; spatial – farm/business, landscape, region; temporal – seasonal and over time)?
		Consistent, standardised and robust methodologies for measuring biodiversity^	1	• What would be the standardised but flexible methods to quantify biodiversity units and gains? • How applicable and effective are the new technologies (e.g. drones, eDNA, AI, remote sensing) to measure and monitor biodiversity? • How to develop consistent measurement approaches, including Indigenous standards for biodiversity? • What are the robust and practical approaches to assessing the impacts of biodiversity-related investment?
		Cost-effective, easy-to-apply, and robust biodiversity metrics, standards, and indicators^	3	• How to develop robust but straightforward biodiversity measurement metrics from farm to regional scales? • What are fit-for-purpose indicators for various purposes or resource management objectives? • What would be key indicators to represent a large portion of biodiversity variations, including key biodiversity indicators based on Indigenous perspectives?
		Managing existing and newly collected biodiversity data to inform decision-making#,^,*	5	• What could be potential correlates, strong measures or proxies for different types and nature of biodiversity? • How to process and translate publicly accessible coarse data into usable formats? • How to aggregate existing biodiversity data and apply machine learning to create actionable insights?

Note: These knowledge gaps are aligned with other WABSI research programs: # Restoration Economy, ^ Data and Information Management, * Building Biodiversity for Thriving Urban Ecosystems

Focus area 3: Value

Value refers to different types of values placed by individuals, communities and society on the type and extent of biodiversity and nature's services. It involves biodiversity and nature valuation in different land use contexts from different perspectives – western science and Indigenous knowledge systems.

TABLE 5. Value: Outcome, objectives, knowledge gaps and their ranking, and example research questions

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
The diverse (market and non-market, including cultural and spiritual) values of biodiversity would be understood by research end-users and stakeholders for various contexts (businesses) and sectors, along with the understanding of biodiversity valuation approaches.	• Develop fit-for-purpose biodiversity valuation methods. • Assess biodiversity valuation from different perspectives and world views, including the Indigenous perspective. • Understand diverse values of biodiversity.	Robust and practical methodologies for biodiversity valuation*	2	• How to develop robust approaches, frameworks and cost-effective tools to value biodiversity benefits (including private, public and co-benefits)? • What valuation tools or approaches are needed to inform policy and investment decisions for different land uses (e.g. farming vs mining) and scales (e.g. farm vs landscape, single vs multiple species)? • How to value biodiversity in multi-functional or multi-objective landscapes (farming and nature, mining and nature)?
		Understanding and integration of diverse values*	1	• What are Indigenous valuation approaches, and how can they be integrated or applied in biodiversity valuation? • How to quantify instrumental, intrinsic and relational values of biodiversity? • How to appropriately value and incorporate cultural and spiritual values of biodiversity into decision-making processes?
		Scale and context dependency of biodiversity values*	3	• How does biodiversity value vary depending on context, the scale of analysis (site-specific, landscape, regional) and the stakeholders involved (developers vs the public)? • How to aggregate context-specific values to inform broader policy decisions?
		Link between biodiversity values and decision-making*	4	• How to translate biodiversity values into actionable insights for decision-making contexts, such as spatial planning, financial systems and land management? • What tools and frameworks exist for biodiversity and natural capital valuation for businesses and others to help in decision-making? How to apply them in different contexts? • How to bridge the gap between the perceived value of biodiversity and the willingness to pay or act for biodiversity conservation?
		Specific and emerging biodiversity values#,^	5	• What is the recreational value of biodiversity and nature? • What are and how much are the health benefits of biodiversity and nature? • What is the value of biodiverse restoration in agricultural terms (opportunity costs)?

Note: These knowledge gaps are aligned with other WABSI research programs: # Restoration Economy, ^ Data and Information Management, * Building Biodiversity for Thriving Urban Ecosystems

Focus area 4: Account for

Account for relates to quantifying the physical amount – extent and condition – and monetary or other forms of values of the stocks and flows of biodiversity and nature for a specified period. It relates to biodiversity and nature accounting frameworks, methods and tools.

TABLE 6. Account for: Outcome, objectives, knowledge gaps and their ranking, and example research questions

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
The contributions of biodiversity and nature would be accounted for using robust methodologies following a consistent or interoperable natural capital accounting framework for a range of land uses and business contexts to aid decision-making.	• Develop and pilot a natural capital accounting framework to document the contribution of nature and biodiversity for different land uses in different (business) contexts. • Develop tools or frameworks to integrate natural capital and biodiversity at varying scales into businesses and public sector decisions.	Consistent and interoperable natural capital accounting frameworks[#,^]	3	• How to develop a fit-for-purpose and consistent framework for natural capital accounting that is aligned with the government's requirements, and that can be applied across different locations, systems, industries, communities and land uses? • What are the ways to align existing natural capital accounting frameworks to enable comparison? • How much interoperability exists among the existing frameworks? What is needed to make it happen?
		Methodologies for biodiversity and natural capital measurement[^]	2	• How to establish the link between the stock and flow of biodiversity and nature's services? • How to account for the scalability issue in biodiversity accounting (impacts, dependency) from a site to a landscape or vice versa? • How can we quantify the links and interactions between biodiversity and other forms of natural capital, like soil and water, in economic terms?
		Integration of biodiversity and natural capital into private (business) and public decisions[#,*]	1	• What are the barriers and opportunities to integrate biodiversity and natural capital into decision-making? • How do accounting standards help to integrate biodiversity and natural capital into corporate decisions? • What operational frameworks are there, and how effective are they in integrating ESG (environment, social and governance) in investment decisions?
		Adaptive natural capital accounting framework that provides insights to landscape-scale interactions and context-specific factors[#,^]	4	• How to develop a localised natural capital accounting framework that is also aligned with national or international frameworks for different sectors? • How to quantify natural capital's contribution to farm productivity, considering the interactions and interlinkages between different natural capital assets that are owned by different owners? • How to develop tools or approaches to establish cause-effect relationships (response function) of farm or landscape activities and biodiversity outcomes, considering externalities (positive or negative interactions)?
		Indigenous perspectives and knowledge in developing natural capital accounting	5	• How to find ways to align Indigenous perspectives and local knowledge in developing or applying the natural capital accounting framework? • How to capture cultural and spiritual perspectives of Indigenous people in biodiversity and natural capital accounting? • What are the key features of an Indigenous natural capital accounting framework? What does it look like?

Note: These knowledge gaps are aligned with other WABSI research programs: # Restoration Economy, ^ Data and Information Management, * Building Biodiversity for Thriving Urban Ecosystems

THEME 2 Mainstreaming

Rationale

Understanding is a necessary condition to mainstreaming biodiversity. Understanding knowledge gaps in different areas of biodiversity economics and finance would contribute to mainstreaming biodiversity and nature in policy and practice for both the private and public sectors. Mainstreaming biodiversity involves creating enabling conditions, better understanding biodiversity economics, establishing functioning biodiversity markets, financing biodiversity programs, and using biodiversity considerations to inform policy and practices. Therefore, knowledge gaps related to these focus areas need to be explored to integrate and mainstream biodiversity into the decision-making process by private and public decision-makers. The outcome, objectives, knowledge gaps and their ranking, along with example research questions, for five focus areas related to mainstreaming biodiversity are presented on the following pages.

Focus area 5: Enabler

Enabler refers to the conditions required for biodiversity and nature's services to be an integral part of private and public deliberations, considerations and activities. In effect, it is about creating an enabling environment for biodiversity and nature to be an important consideration in decision-making.

TABLE 7. Enabler: Outcome, objectives, knowledge gaps and their ranking, and example research questions

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
Through research program implementation, an enabling environment would be created for biodiversity and nature conservation based on cross-sector collaborations, including integration of Indigenous knowledge systems and relevant policy frameworks.	• Strengthen collaboration with government, industry and key stakeholders to improve and develop enabling conditions so that biodiversity becomes an integral part of decision-making. • Create an enabling environment for biodiversity markets, integration of Indigenous knowledge systems, and develop skills and capacity for enhanced biodiversity conservation.	Policy framework and de-risking mechanisms to take action on biodiversity#	2	• What are the most effective financial and non-financial incentives to motivate businesses to minimise their adverse impacts on biodiversity and nature? • What de-risking mechanisms are there to increase private sector nature-related investments? • What incentive or disincentive structures will motivate reporting and actions on nature-related impacts and dependencies? • What is the risk appetite of businesses and governments regarding the integration of nature into business models? • What type of coordinated and whole-of-government approach on biodiversity and natural capital would help to foster nature and the economy in Western Australia?
		Enabling conditions for biodiversity markets	3	• What regulatory clarity would be needed for biodiversity markets? • How to integrate Indigenous social and cultural aspects into the biodiversity and nature repair markets • How can biodiversity be stacked or bundled to combine different aspects of nature (biodiversity, carbon, water etc.) within the biodiversity market? • What type of enforcement and governance mechanisms are needed to build trust and confidence in biodiversity markets?
		Clear, consistent and integrated policies and regulatory frameworks to drive action#	1	• What type of policy reforms are needed to align biodiversity goals with economic development, particularly in sectors like mining and agriculture? • How to improve existing policies for better biodiversity outcomes? • What are the ways to provide policy certainty for investment in biodiversity and nature for long-term planning? • How to assess and develop a mechanism to provide policy coherence across jurisdictions?
		Cross-sectoral collaboration and integration of Indigenous knowledge	5	• How to develop effective models and strategies to promote cross-sectoral collaboration (between industries, government, community and research institutions)? • How effective is biodiversity conservation that is based on Indigenous knowledge and practices? • What are the biodiversity outcomes of following Indigenous knowledge or perspectives in measurement, valuation and accounting of natural capital and biodiversity?
		Integration of biodiversity into all levels of decision-making and land use planning#	4	• What are effective incentives and approaches to change human behaviour towards biodiversity conservation? • What enabling policies and environment are required to integrate biodiversity into local-level decisions? • How to resolve land tenure and land use issues to mainstream biodiversity and nature in land use plans? • What strategic land use plans and policy interventions are needed to mainstream biodiversity?

Note: These knowledge gaps are aligned with another WABSI research program: # Restoration Economy

Focus area 6: Economics

Economics relates to quantifying and analysing the direct and indirect benefits and costs of biodiversity conservation as well as continuing biodiversity loss.

TABLE 8. Economics: Outcome, objectives, knowledge gaps and their ranking, and example research questions

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
The end-users or key stakeholders would be aware of the economic benefits of biodiversity and the costs associated with its loss through a better understanding of the link between biodiversity, economic activity and human well-being, thereby providing a rationale to integrate biodiversity into economic decisions.	• Quantify the costs of inaction to biodiversity loss in multiple land uses, economic sectors and business contexts. • Estimate the benefits of biodiversity protection from economic as well as other (cultural and spiritual) perspectives. • Examine the interconnections between biodiversity, economic activity and human well-being.	Economic value and benefits of biodiversity	1	• What are the robust methods and models to estimate the economic value of biodiversity, including forecasting models for restoration outcomes? • Are there enough proof-of-concept or pilots to show that investing in biodiversity conservation is a sound economic case? • How to estimate the economic or cultural value of biodiversity using Indigenous valuation approaches?
		Costs of biodiversity loss, and biodiversity as an investable asset	2	• What is the quantifiable cost of inaction to biodiversity loss (private as well as public)? • What are the long-term economic consequences of biodiversity decline, including reduced or lost ecosystem services, such as pollination for farmers? • What are the social and cultural costs of biodiversity loss to Indigenous communities?
		Market-based mechanisms and incentives for biodiversity conservation	5	• What is known about the complexities of establishing and operating biodiversity markets, including transaction costs, market failures and incentive compatibility? • What are the main factors affecting the demand and supply of biodiversity certificates or credits? • How to design effective incentives (‘carrot and stick’) to incorporate biodiversity into industry practices or business models?
		Connections between biodiversity, economic activities and human well-being	3	• What is the economic link between the state of biodiversity and human health, particularly for communities? • What are the benefits of investing in biodiversity and natural capital for improved public health outcomes? • What are the value propositions to farmers, businesses and industry so they see clear benefits of adopting biodiversity-friendly practices?
		Operational challenges in biodiversity conservation	6	• What are the pros and cons of biodiversity insetting vs trading? • What would be the cost-efficient ways to conserve biodiversity in heterogeneous agricultural lands? • How would frameworks and tools be used to assess transaction costs associated with biodiversity markets?
		Integration of biodiversity into economic and policy decisions#, ^, *	4	• What are the most appropriate ways to integrate biodiversity values into economic and policy decisions, and how to do it? • What is known about the link between biodiversity protection and positive economic outcomes? • What would be the effective way to communicate the economic benefits of biodiversity to decision-makers in their decision contexts? • What is the biodiversity risk appetite of governments so that areas for improvement can be identified?

Note: These knowledge gaps are aligned with other WABSI research programs: # Restoration Economy, ^ Data and Information Management, * Building Biodiversity for Thriving Urban Ecosystems

Focus area 7: Market

Market characterises the mechanism by which biodiversity units or nature's services are traded in the marketplace, including their price and quantity. It focuses on demand and supply sides of biodiversity units and nature's services.

TABLE 9. Market: Outcome, objectives, knowledge gaps and their ranking, and example research questions

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
A sound understanding of biodiversity markets (credits or certificates), including demand, supply, risks and price uncertainty, and how they would be developed for proper functioning of the market.	• Understand the demand and supply-side factors of the biodiversity market for Western Australia. • Conduct market analysis of biodiversity credits or certificates with a focus on risks and price uncertainty. • Identify dominant players in the biodiversity market and the market risks.	Demand and supply side of the biodiversity market#	1	• What is the effective demand for biodiversity certificates or credits, particularly from the private sector? • What is the state of the biodiversity credit market – the extent and quality of demand? Who are the buyers? And what are they buying? • What are the demand-side and supply-side risks of biodiversity certificates or credits? • What are and how to develop de-risking approaches for biodiversity market participants? • What are the supply and demand dynamics of biodiversity markets, and what do they tell us about the future of these markets?
		Market designs and mechanisms	5	• What do we know about biodiversity market design, including how to define what is being protected or conserved and for how long? • How does the biodiversity market work for resource companies that do not have their own land? • What does good look like in the case of biodiversity markets? • Demonstrate what a rigorous biodiversity market looks like that avoids perverse impacts.
		Biodiversity market sensitivity and price uncertainty	4	• What are the sensitive elements of the biodiversity market, e.g. price? • What are the different ways of creating biodiversity certificates – stacked and solo certificates – and how price sensitive are they? • How does the composition of biodiversity types affect the value of certificates? • How to price biodiversity risks for businesses or different sectors of the economy?
		Integration and applicability of biodiversity markets across the sectors and contexts	3	• Which of the options (insetting or trading) for biodiversity certificates would be optimal for different landholders in different contexts? • How can Indigenous approaches to biodiversity management be linked to biodiversity markets? • What do Indigenous standards look like for the nature repair market in different Indigenous contexts?
		Effectiveness, integrity, and risks of biodiversity markets	2	• How effective are the biodiversity offsets, including their tenure security? • What are the risks and opportunities associated with different approaches (stacking or bundling) in issuing certificates? • What is the performance of biodiversity compliance markets? • What are the regulatory or government approaches for biodiversity markets in Western Australia?

Note: These knowledge gaps are aligned with another WABSI research program: # Restoration Economy

Focus area 8: Finance

Finance relates to the concept of biodiversity and nature as an investable asset, and the ways (tools and instruments) to finance their conservation and management for private and public benefits. It is related to financing products, mechanisms and challenges in biodiversity and nature financing.

TABLE 10. Finance: Outcome, objectives, knowledge gaps and their ranking, and example research questions

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
The state of biodiversity finance for Western Australia would be understood alongside potential investors' expectations and risk profiles and the development of biodiversity financing products.	• Develop a business case for investing in biodiversity and nature. • Estimate the existing biodiversity finance in Western Australia through different mechanisms (public, private, philanthropic, blended etc.). • Understand the implementation challenges and impact of biodiversity-focused financial products. • Understand the biodiversity risk appetite of investors, different sectors or businesses, and governments.	Extent, nature and impact of existing biodiversity finance	4	• What is the extent and type of biodiversity (private) financing in Western Australia? • How effective are the nature-linked financial instruments, such as green bonds on biodiversity outcomes? • What are the new and promising biodiversity and nature finance models, governance mechanisms and instruments that are suitable for Western Australia (e.g. revolving fund, philanthropy)?
		Financial mechanisms and instruments for biodiversity	3	• What is the feasibility (potential) of creating a private exchange (trading platform) for biodiversity? • What is the feasibility of bundling financial instruments together for carbon and biodiversity credits? • Can nature-linked financial instruments be developed that target different forms and scales of biodiversity (e.g. species to landscape)? • How feasible and scalable are existing biodiversity-focused financial instruments?
		Biodiversity value and financial decision-making	5	• How can biodiversity values be translated into financially viable models for industry? • What financial models exist for equitable sharing of biodiversity risks and rewards between landholders and upstream supply chains? • What are and how to develop trusted methodologies to quantify the financial value of biodiversity actions for businesses or the financial sector and investors?
		Investors' motivations, risk appetite and return expectations#	2	• What are the private sector's motivations (risk avoidance strategies) for biodiversity finance, and how can these risks be costed? • What are the principal drivers of biodiversity investment, such as social licence, reputational risk, legislative risk and material financial risk? • What is the appetite of investors for the rate of return in biodiversity-focused investment? • What are investors' biodiversity risk profiles (cost, disclosure, regulation and data availability)?
		Enablers and barriers to biodiversity finance	1	• What enablers are already in place and what additional enablers need to be implemented to increase biodiversity financing in Western Australia? • What are the potential barriers to biodiversity investment, such as the lack of financial incentives for businesses to invest in biodiversity, the perceived high-risk profile of biodiversity projects, and the lack of financial and policy incentives? • How robust and effective are the financial instruments and tools, such as biodiversity credits, to generate biodiversity finance?
		Frameworks for ESG integration and biodiversity disclosure	6	• What type of framework or tool would allow businesses to develop ESG credentials? • What is the significance and likely effectiveness of financial disclosure by Western Australian agencies or corporations?

Note: These knowledge gaps are aligned with another WABSI research program: # Restoration Economy

Focus area 9: Practice

Practice refers to applying or integrating biodiversity and nature's services into economic and financial decisions and policy making by the private and public sectors. It is the main component of mainstreaming biodiversity at operational levels.

TABLE 11. Practice: Outcome, objectives, knowledge gaps and their ranking, and example research questions

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
Biodiversity considerations become an integral part of private and public decisions across the sectors, and businesses are supported by decision-making frameworks, tools and policy measures.	• Understand the potential of mainstreaming biodiversity across various sectors in Western Australia. • Assess the effect of regulatory measures on mainstreaming biodiversity. • Understand challenges and potential solutions in embedding biodiversity considerations in decision-making, as well as in business practices.	Natural capital accounting framework and mainstreaming biodiversity and nature across sectors in Western Australia[#,^,*]	4	• What would be, and how to develop and apply, a coordinated natural capital accounting policy framework to mainstream biodiversity and nature into operational decisions across sectors? • What is the risk appetite of the financial sector, and what aspects of biodiversity and nature would be invested in or scaled up? • How to align biodiversity considerations and priorities between different sectors (e.g. mining and agriculture)? • How to initiate a shift from the compliance paradigm to the proactive biodiversity stewardship paradigm in all relevant sectors?
		Inter-connections between biodiversity, climate change and development[#,*]	6	• What would be the optimal way to balance competing demands on land for different purposes, such as conservation, agriculture, housing and other economic activities? • How to make biodiversity considerations an integral part of broader environmental and economic goals in practice? • How to develop integrated strategies to address climate change and biodiversity loss simultaneously?
		Regulatory measures for mainstreaming biodiversity[#]	2	• What types of regulatory measures would be needed to mainstream biodiversity? • How to measure the effectiveness of regulatory measures to mainstream biodiversity? • What types of regulatory measures would work best across different in the Western Australian context?
		Scaling up biodiversity initiatives	3	• How to scale up evidence or findings from one case study to the landscape level or other sites and contexts? • How to scale up measurement from a single site to the ecosystem level? • How to scale up what is already known about biodiversity conservation by businesses to other sectors? • How to overcome the 'transferability problem' in biodiversity measurement, valuation and program implementation?
		Practical tools and frameworks for decision-making[#,*]	1	• What tools, frameworks and approaches are available to embed cultural values and social resilience into biodiversity assessments? • How to develop an adaptive decision-making tool for a range of operational situations: post mining land use, strategic land use, primary production or farming areas? • How to generate easy-to-use (applied) information suitable for different decision-making contexts? • What guidance is needed on how to develop biodiversity scenarios for Western Australia into the future?
		Facilitating effective stakeholder engagement and systemic change[#,*]	5	• What systemic changes are needed within industries to integrate biodiversity into long-term land use and development plans? • What are the effective engagement approaches among stakeholders across sectors to collaborate on biodiversity conservation? • What are the areas for improvement and opportunities for systemic change across sectors to mainstream biodiversity?

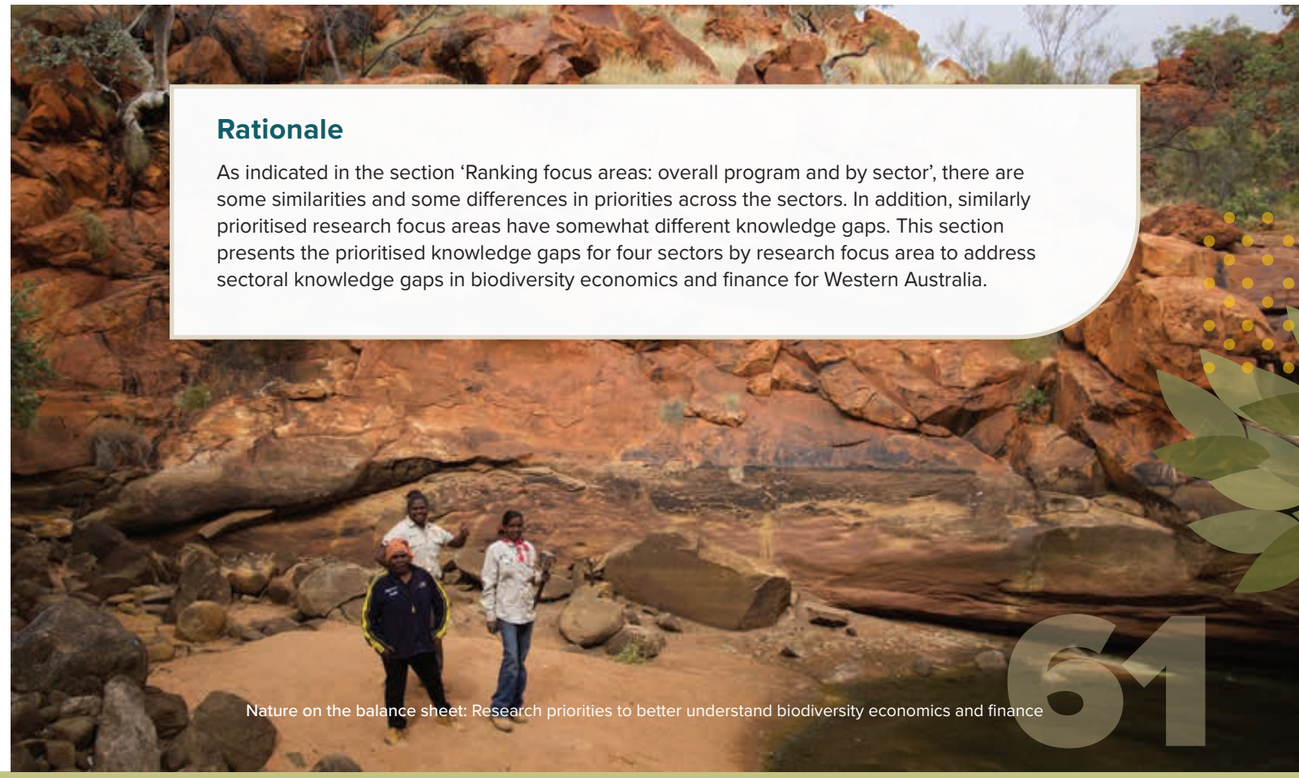
Note: These knowledge gaps are aligned with other WABSI research programs: # Restoration Economy, ^ Data and Information Management, * Building Biodiversity for Thriving Urban Ecosystems

Indigenous perspectives on research priorities in biodiversity economics and finance

During the course of identifying knowledge gaps in biodiversity economics and finance and prioritising them for research, we consulted a number of Indigenous scholars, some of whom were able to participate in the workshops. Their observations and comments are embedded in the prioritised program. Some key areas of research priorities from Indigenous perspectives:

- System's approach to assess the role of biodiversity as a component of the living system
- Spiritual and cultural values of biodiversity
- Indigenous standards and metrics to measure biodiversity
- Indigenous ways of compiling natural capital accounts
- Integration of Indigenous local knowledge systems into financial models
- Ways to enhance intergenerational stewardship of biodiversity and nature
- Effective mechanisms for equitable access to biodiversity finance for Indigenous bottom-up opportunities
- Ways to develop innovative partnerships with other stakeholders (e.g. NRM groups) in biodiversity management
- Exploring bioregional frameworks and biocultural governance in biodiversity management
- How to live in harmony with biodiversity in the face of growing environmental pressures.

Part B: Ranking of key knowledge gaps by sector and focus area



Rationale

As indicated in the section 'Ranking focus areas: overall program and by sector', there are some similarities and some differences in priorities across the sectors. In addition, similarly prioritised research focus areas have somewhat different knowledge gaps. This section presents the prioritised knowledge gaps for four sectors by research focus area to address sectoral knowledge gaps in biodiversity economics and finance for Western Australia.

Primary production sector

Focus area 1: Learn

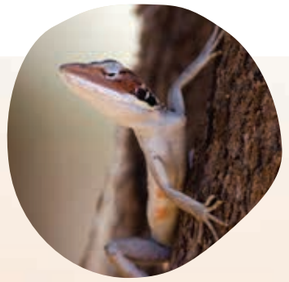
TABLE 12. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Learn focus area in the primary production sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
Research end-users and landholders would develop clarity on the link between biodiversity and farming businesses and would be able to articulate the need to integrate biodiversity into land use decisions.	• Understand the link between biodiversity and farming. • Understand ecological interactions and their economic implications in farming contexts.	The return from biodiversity and natural capital	1	• What can landholders realistically achieve from biodiversity and natural capital on their lands? • What are the links between natural capital investments and improved productivity outcomes (e.g. reduced health costs, green jobs) in the primary production sector?
		No-regret nature-based solutions	3	• What are the no-regret, nature-based solutions that can collectively enhance regional opportunities (e.g. south-west of Western Australia)? • What are the opportunities to link farming and biodiversity that could improve farmers' understanding of the value of biodiversity-friendly practices?
		Guidance to integrate biodiversity into different types of farms	2	• What is the practical guidance on how to integrate biodiversity into existing farming practices?
		Sectoral dependency on biodiversity components	4	• What is the extent (quantitatively) of dependency of different farming sectors on different components of biodiversity and natural capital?

Focus area 2: Measure

TABLE 13. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Measure focus area in the primary production sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
There would be improved measurement and access to biodiversity data in the primary production sector with the use of standardised and robust measurement metrics and methods.	• Develop fit-for-purpose biodiversity data metrics and measurement methods for different land use contexts. • Improve biodiversity measurement approaches and tools by developing frameworks and guidance. • Develop ways to gain insights from new and existing biodiversity data to support decisions.	Data availability and access	4	• What are the baseline biodiversity data for different farming enterprises (crops, horticulture, livestock, pasture) in different farming regions? • How to develop fit-for-purpose data for decision-makers at different scales (firm, household, industry, region)? • How to improve access to existing biodiversity data to gain insights for decision-making? • What tools would address data transferability and use in farming contexts? • How to standardise measurement tools for biodiversity and natural capital?
		Measurement metrics, methods and tools	1	• What would be, and how to develop, a standardised and consistent approach to measure biodiversity at genetic, species and ecosystem levels? • How to forecast the biodiversity outcomes of farming activities, i.e. what are the response functions? • What are the standardised methods of quantifying biodiversity units or gains (i.e. indicator, metric and measurement approaches)? • How to maintain a balance (trade-off) between perfect and practical biodiversity metrics?
		Benchmarking and monitoring of biodiversity data	3	• Are there established benchmarks (baseline) for progress monitoring for biodiversity outcomes? • How to ensure continuity of data to develop a better understanding through periodic monitoring?
		Data collection technology	2	• What would be, and how to develop, cost-effective technologies to gather granular biodiversity data at farm (landholder) level?



Focus area 3: Value

TABLE 14. Outcome, objectives, knowledge gaps and ranking, and example research questions for the Value focus area in the primary production sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
The diverse values and valuation approaches of biodiversity would be understood by program stakeholders and end-users in the primary production sector.	• Develop fit-for-purpose valuation methods. • Assess biodiversity valuation from diverse perspectives, including the Indigenous worldview. • Understand diverse values of biodiversity.	Diverse values and valuation techniques	2	• What are the diverse values of biodiversity in the primary production sector and how can we elicit such diverse values? • How to value biodiversity in multi-functional/ multi-objective landscapes, e.g. carbon, farming, natural capital accounting etc.? • What would be the biodiversity valuation approaches in the context of the government's shift towards restoration and carbon and ecosystem service markets?
		Valuation protocol or guidance	1	• How do landholders become certain about the value and practical integration of biodiversity and natural capital into farming? How do they do it? • How to value biodiverse restoration outcomes in agricultural terms (relative to agricultural outcomes)?

Focus area 4: Account for

TABLE 15. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Account for focus area in the primary production sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
The contributions of biodiversity and nature to primary production across different land uses would be accounted for based on an interoperable natural capital accounting framework.	• Develop and pilot a natural capital accounting framework to document the contribution of biodiversity and nature for different land use types (e.g. cereal crops, horticulture, livestock). • Develop tools or frameworks to integrate biodiversity and nature at varying scales into private and public sector decisions.	Dependency assessment	1	• To what extent different primary production sectors (cereal crops, livestock, horticulture, forestry etc.) depend on biodiversity and natural capital • How to assess biodiversity and nature dependency and what tools are helpful?
		Fit-for-purpose natural capital accounting framework	3	• What would be the ideal (fit-for-purpose, consistent but flexible) framework to account for the role of biodiversity according to specific needs of farming systems, primary industry, community (e.g. Indigenous) and land uses?
		Biodiversity monitoring	2	• What would be a cost-effective, long-term monitoring program to track biodiversity changes over time in the primary production sector?

Focus area 5: Enabler

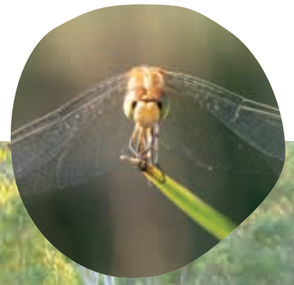
TABLE 16. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Enabler focus area in the primary production sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
An enabling environment would be developed for enhanced cross-sector collaborations and integration of Indigenous knowledge systems on biodiversity into relevant policy frameworks.	• Strengthen collaboration with government, industry and key stakeholders to improve and develop enabling conditions so that biodiversity is considered as an integral part of decision-making. • Create an enabling environment for biodiversity markets, and develop skills and capacity for enhanced biodiversity assessment. • Create enabling conditions and integrate Indigenous knowledge into the biodiversity market and natural capital accounting.	Engagement with landholders or service providers	4	• What would be a cross-sectoral collaboration (government, industry, community) framework in biodiversity assessment and natural capital accounting? • How best to engage landholders and service providers in biodiversity and nature-related investment while ensuring equity in risk and reward? • What are the priority areas of collaboration with the government, industries (Meat & Livestock Australia, as an example) and NRM sectors?
		Skills, capacity and resource gaps	3	• How best to address the gap in natural capital expertise and capacity in Western Australia? • What needs to be done, including resource allocation, to bring long-term changes in biodiversity and natural capital and to alter landholder behaviour?
		Pilots or successful models	6	• What would be a regional coordination mechanism to pilot biodiversity projects in specific regions (e.g. south-west of Western Australia) as a foundation to develop a broader biodiversity market? • What are the successful working models in natural capital from other states or countries that are applicable to Western Australia? • What operational framework would enable the benefits of biodiversity conservation or nature protection to reach communities, particularly Indigenous communities?
		Risk sharing	5	• What government support or de-risking approach is needed to reduce investment risks for private sectors?
		Alignment of goals and monitoring	1	• How to align long-term goals (vision) with practical and short-term (financial and actionable) outcomes? • What needs to be done to establish long-term monitoring programs that can track the effectiveness of biodiversity initiatives and support evidence-based decision-making?
		Regulatory and policy clarity	2	• How best to provide regulatory clarity (policy certainty) for biodiversity markets? • What would be the government's role in creating regulatory frameworks and supporting the development of natural capital markets, including from Indigenous perspectives?

Focus area 6: Economics

TABLE 17. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Economics focus area in the primary production sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
The cost of inaction, and the economic benefits of biodiversity and nature, including well-being and cultural benefits, within the primary production sector become clearer to knowledge stakeholders and end-users.	• Quantify the costs of inaction to biodiversity loss in multiple land uses within the primary production sector. • Estimate the benefits of biodiversity and nature protection from economic as well as other (cultural and spiritual) perspectives. • Examine the interconnections between biodiversity, economic activity and human well-being.	Quantifying the benefits and forecasting	1	• What are, and how much is, the financial or economic benefits of biodiversity improvement over time? • How to develop forecasting models to value biodiverse restoration outcomes? • How to quantify the long-term economic benefits of biodiversity and natural capital investments?
		Cost of inaction vs cost of taking action	2	• What is the cost of inaction due to biodiversity loss for the primary production sector? • What is known about cost-efficiencies for farmers to switch from current practice to biodiversity-focused agricultural (or other) practices?
		Role of insetting	3	• What would be the impact of insetting by primary production sectors (agriculture and NRM) on biodiversity credit or certificate markets?
		Biodiversity and natural capital investment and well-being outcomes	4	• What are the economic benefits of natural capital investments on improved well-being outcomes (reduced costs of health care)?



Focus area 7: Market

TABLE 18. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Market focus area in the primary production sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
A sound understanding of demand, supply, risks and price uncertainty of biodiversity credits or certificates would be achieved for a robust and functioning biodiversity market.	• Understand the demand and supply-side factors of the biodiversity credit or certificate market. • Conduct market analysis of biodiversity credits or certificates. • Identify dominant market players and biodiversity market risks.	Scope of biodiversity market	3	• How can carbon and biodiversity markets work together so landholders can diversify income? • What integrated approaches to conserving biodiversity would work best with existing farming practices? • What type of knowledge and skills are needed to develop a biodiversity market in the NRM sector?
		Demand for biodiversity credits or certificates	1	• What is the state of demand and supply for biodiversity credits or certificates? • What can be supplied (in what units) to the market and what are the trade-offs? • How can the demand for biodiversity credits or certificates be quantified and tracked? • What does a viable biodiversity credit trading system for Western Australia look like?
		Market (demand and supply) analysis	4	• What is known about the supply and demand dynamics of biodiversity credit or certificate markets? • How to integrate supply and demand dynamics into existing market mechanisms or frameworks?
		Optimal choice – insetting vs selling	2	• Which option, and in what context, would be optimal for insetting or selling biodiversity credits or certificates by landholders?

Focus area 8: Finance

TABLE 19. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Finance focus area in the primary production sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
The state of biodiversity finance for Western Australia would be understood alongside biodiversity financing products and potential investors, and other stakeholders' expectations and risk profiles.	• Develop a business case for investing in nature. • Estimate the existing biodiversity finance in Western Australia through different mechanisms. • Understand the implementation challenges and impact of biodiversity-focused financial products. • Understand the biodiversity risk appetite of investors, businesses and governments.	Financial incentives	1	• What are the financial incentives and value propositions to encourage landholders to participate in the biodiversity market? • What would be the financial models for equitable sharing of risks and rewards between landholders (who bear the risks) and upstream supply chains (who reap the rewards)? • How to address the imbalance in risk-reward distribution and ensure long-term financial sustainability for biodiversity and natural capital projects?
		Investment climate	3	• How to ensure continuity of investment in long-term biodiversity assessment and natural capital accounting? • How to ensure funding sources for biodiversity and natural capital projects? • How to reduce the risk of investment in biodiversity and natural capital projects?
		Barriers to investment	2	• What non-market barriers exist for biodiversity investment? • What is the risk appetite of investors, businesses and government in the biodiversity (certificate or credit or other) market and nature-focused products and investments?

Focus area 9: Practice

TABLE 20. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Practice focus area in the primary production sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
Biodiversity considerations would become an integral part of private and public decisions across the primary production sector, supported by decision-making frameworks, tools and policies.	• Understand the potential of mainstreaming biodiversity across various primary production sectors in Western Australia. • Assess the effect of regulatory measures on mainstreaming biodiversity. • Understand the challenges and potential solutions to integrate biodiversity considerations into business practices.	Balancing top-down and bottom-up approaches	1	• What would be a balanced approach between bottom-up and top-down ways of thinking about biodiversity measurement, financing and mainstreaming?
		Prospective analysis of costs of inaction at scale	4	• What would be the estimated costs to Western Australia's economy for inaction or not investing in biodiversity or not mainstreaming biodiversity into decision-making by the primary production sector?
		Policy certainty and clarity on financial incentives	3	• What are the financial incentives for landholders to engage in biodiversity projects, particularly in areas where benefits accrue in the long-term and are abstract?
		Alignment of landholders' objectives and government priorities	2	• How can farmers or landholders align natural capital projects with government priorities and processes to minimise regulatory risks?

Resources sector

Focus area 1: Learn

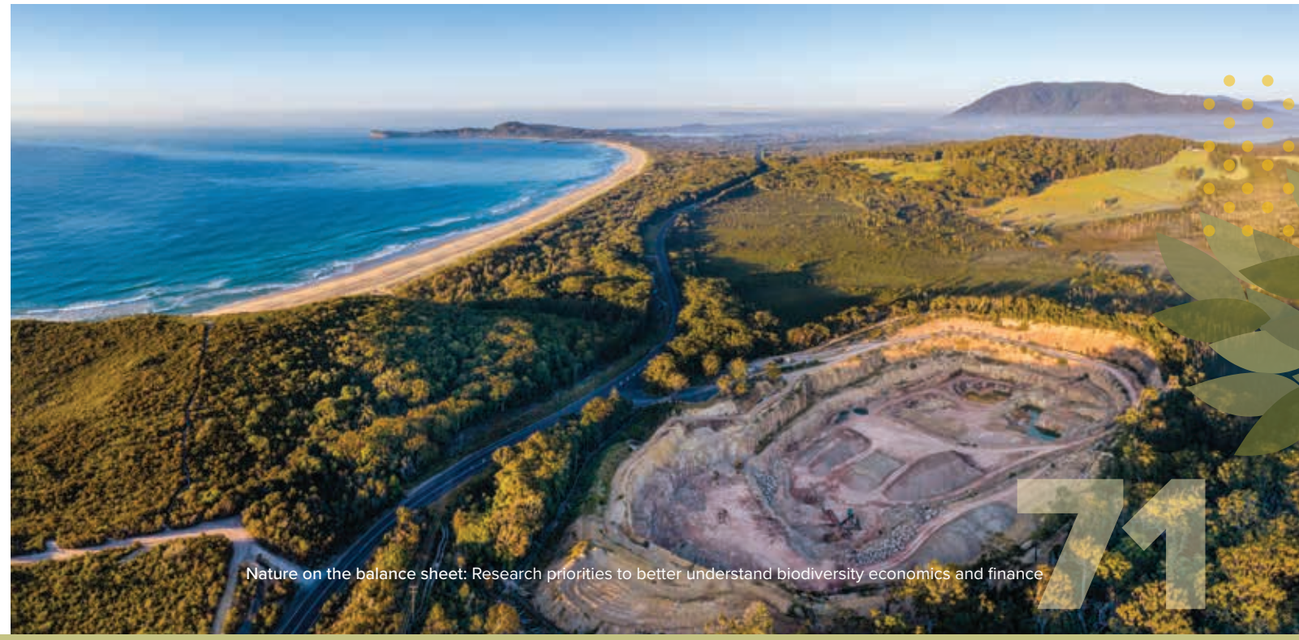
TABLE 21. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Learn focus area in the resources sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
Research end-users and stakeholders would develop better clarity on the link between biodiversity and resource businesses, and be able to articulate the need to integrate biodiversity into land use and business decisions.	• Understand the link (dependency and impacts) between biodiversity and the resources industry. • Understand ecological interactions and their economic implications in the resources sector.	Balancing land use priorities and biodiversity conservation	5	• What are, or how to develop, robust and practical strategies to balance biodiversity conservation with land use priorities for the resources sector? • What can be learned and applied in Western Australian contexts from global case studies for land use priorities, such as from Brazil?
		Restoration and biodiversity conservation	2	• How to effectively apply and scale up restoration and biodiversity conservation efforts with a focus on long-term climate adaptation within the resources sector? • What are innovative restoration techniques, especially considering the changing climate and the need for species adaptation? • What are the ways to improve the effectiveness of restoration projects, particularly in areas with limited ecological knowledge where resource businesses are active?
		Community awareness	3	• What are effective ways to bridge the gaps between technical and community understanding of biodiversity, which is essential for broader adoption of practices or interventions?
		Understanding policy landscape and risks	4	• What are the risks of moving too fast without sufficient regulation or policy certainty? • How to avoid undermining biodiversity conservation efforts and discourage investments in the sector?
		Climate smart conservation	6	• How can biodiversity conservation strategies be adapted to address the challenges of climate change, particularly with shifting species? • How to design biodiversity projects that can accommodate both current and future climatic conditions?
		Understanding technology	1	• How to use technology (e.g. remote sensing or new technologies) effectively to improve biodiversity monitoring in the resources sector?

Focus area 2: Measure

TABLE 22. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Measure focus area in the resources sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
There would be improved measurement and access to biodiversity data in the resources sector with the use of standardised and robust measurement metrics and methods.	• Develop fit-for-purpose biodiversity data metrics and measurement methods applicable to the resources sector. • Improve biodiversity measurement approaches and tools by developing frameworks and guidance. • Develop access to and insights from new and existing biodiversity data to support decisions.	Measurement methods	2	• What type of methodology is feasible and adaptive to measure biodiversity, especially given the uncertainty, as methods can vary across regions and sectors (e.g. terrestrial vs aquatic)? • What would be the consistent and standardised methods for measuring biodiversity for accounting and regulatory purposes (need for frameworks, tools and guidance) for the resources sector? • How to develop a standardised approach to measure biodiversity that works across the resources sector and regions?
		Data and metrics	1	• What are the key elements (or proxies) to identify priority metrics for biodiversity? • How to translate existing data on biodiversity and ecosystems to develop actionable insights and metrics? • What are the most critical gaps in biodiversity data and ways to address them through research and innovation? • What are the standardised metrics to measure biodiversity across different ecosystems?
		Quantifying impacts and risks	3	• How to quantify biodiversity impacts accurately with existing data uncertainty and research gaps, especially for aquatic ecosystems? • What are the risks of implementing biodiversity strategies without clarity on methodologies and metrics to measure success, leading to ineffective or costly outcomes?



Focus area 3: Value

TABLE 23. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Value focus area in the resources sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
The diverse values and valuation approaches of biodiversity would be understood by knowledge stakeholders and end-users in the resources sector.	• Develop fit-for-purpose valuation methods. • Assess biodiversity valuation from diverse perspectives, including the Indigenous worldview. • Understand the diverse values of biodiversity.	Holistic valuation method or approach	1	• How to conduct a valuation (or what approach to valuation) that would capture the economic, cultural and religious values of biodiversity to society?
		Valuation of biodiversity for financial decisions	3	• How to value biodiversity in financial terms, especially in conveying these values to investors or decision-makers who may not fully understand or prioritise biodiversity? • What are the most effective approaches to valuing biodiversity in monetary terms for decision-making?
		Solutions to the complexities of monetary valuation	2	• What are the complexities of valuing biodiversity in dollar terms to justify investment to stakeholders and decision-makers? • What would be the solution to the complexity of assessing biodiversity and ecosystem services, including intangible values like cultural or spiritual significance?

Focus area 4: Account for

TABLE 24. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Account for focus area in the resources sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
The contributions of biodiversity and nature to the resources sector would be accounted for based on an interoperable natural capital accounting framework.	• Develop and pilot a natural capital accounting framework to document the contribution of biodiversity and nature broadly to the resources sector. • Develop tools or frameworks to integrate biodiversity and nature at varying scales into private and public sector decisions.	Scope of natural capital accounting to integrate biodiversity into planning and assessment	2	• In what ways does natural capital accounting offer significant potential to incorporate biodiversity into financial planning to attract private sector investments in biodiversity initiatives? • How to embrace the opportunity to embed natural capital accounting into systems like environmental impact assessments (EIAs) to demonstrate practical, measurable biodiversity outcomes?
		Landscape approach and partnership	1	• How to account for biodiversity appropriately at the landscape level? • What are ways to foster landscape-scale approaches to restoration, including partnerships between governments, landowners and local communities, which can drive biodiversity outcomes across regions?
		Best practice for offsets	3	• What are the best practices for designing and implementing biodiversity offsets that are both effective and equitable?

Focus area 5: Enabler

TABLE 25. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Enabler focus area in the resources sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
An enabling environment would be developed for enhanced cross-sector collaborations and integration of Indigenous knowledge systems on biodiversity to relevant policy frameworks.	• Strengthen collaboration with government, industry and key stakeholders to improve and develop enabling conditions to consider biodiversity as an integral part of decision-making. • Create an enabling environment for biodiversity markets, and develop skills and capacity for enhanced biodiversity assessment. • Create enabling conditions and integrate Indigenous knowledge into designing a biodiversity market or natural capital accounting.	Providing policy certainty	3	• How to provide policy certainty around biodiversity offsets and how to integrate them into long-term land use planning? • What are effective ways to leverage policy to drive industry action, with clear, simplified rules and incentives for biodiversity conservation (e.g. through offset mechanisms or restoration funding)? • What policy reforms are needed to align biodiversity goals with economic development, particularly in the resources sector? • How can long-term biodiversity strategies be developed against the complexities created by short-term policy priorities?
		Cross-sector collaboration	2	• How to exploit the potential of Western Australia to position itself as a global leader in biodiversity, restoration and natural capital management? • How to collaborate across sectors (mining, agriculture etc.) to achieve biodiversity outcomes, while aligning different and challenging interests? • How to develop a better collaboration between industries, government and research institutions to share knowledge and scale up conservation and restoration efforts?
		Land use plan for biodiversity enhancement	1	• What are effective ways to implement strategic land use planning and policy interventions to enhance biodiversity, including the establishment of biodiversity corridors or securing land for conservation?
		Policy adoption risk	6	• How to maintain a balance between speed of policy change and industry's ability to implement policy to avoid risks of regulatory misalignment?
		Incentivising the private sector	5	• What government policies are needed to incentivise private sector investments in biodiversity conservation?
		Integrating social licence into biodiversity initiatives	4	• How to integrate insights from social sciences into biodiversity initiatives to change public attitudes and drive public engagement through community-driven efforts?

Focus area 6: Economics

TABLE 26. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Economics focus area in the resources sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
The economic benefits of biodiversity, including well-being and cultural benefits, as well as the cumulative impacts of projects on biodiversity within the resources sector, become clearer to research end-users and other stakeholders.	• Assess cumulative impacts and values. • Estimate the benefits of biodiversity and nature protection from economic as well as Indigenous (i.e. well-being) perspectives. • Assess effective ways to communicate biodiversity benefits to decision-makers in their decision contexts.	Assessing cumulative impacts and values	1	• How to assess effectively the cumulative impacts of resource projects on biodiversity and associated societal values (e.g. benefits and costs to health)?
		Effective ways to communicate biodiversity benefits	3	• How to communicate the economic benefits of biodiversity, such as ecosystem services, to decision-makers in their context of decision-making? • What are the well-being benefits of biodiversity for Indigenous communities, and how to communicate them to influence decision-making?
		Quantifying the benefits of biodiversity investment	2	• How to develop a proof-of-concept for investing in biodiversity to make it a sound economic case? • What are the clear benefits for businesses and industry players to encourage them to adopt biodiversity-friendly practices?

Focus area 7: Market

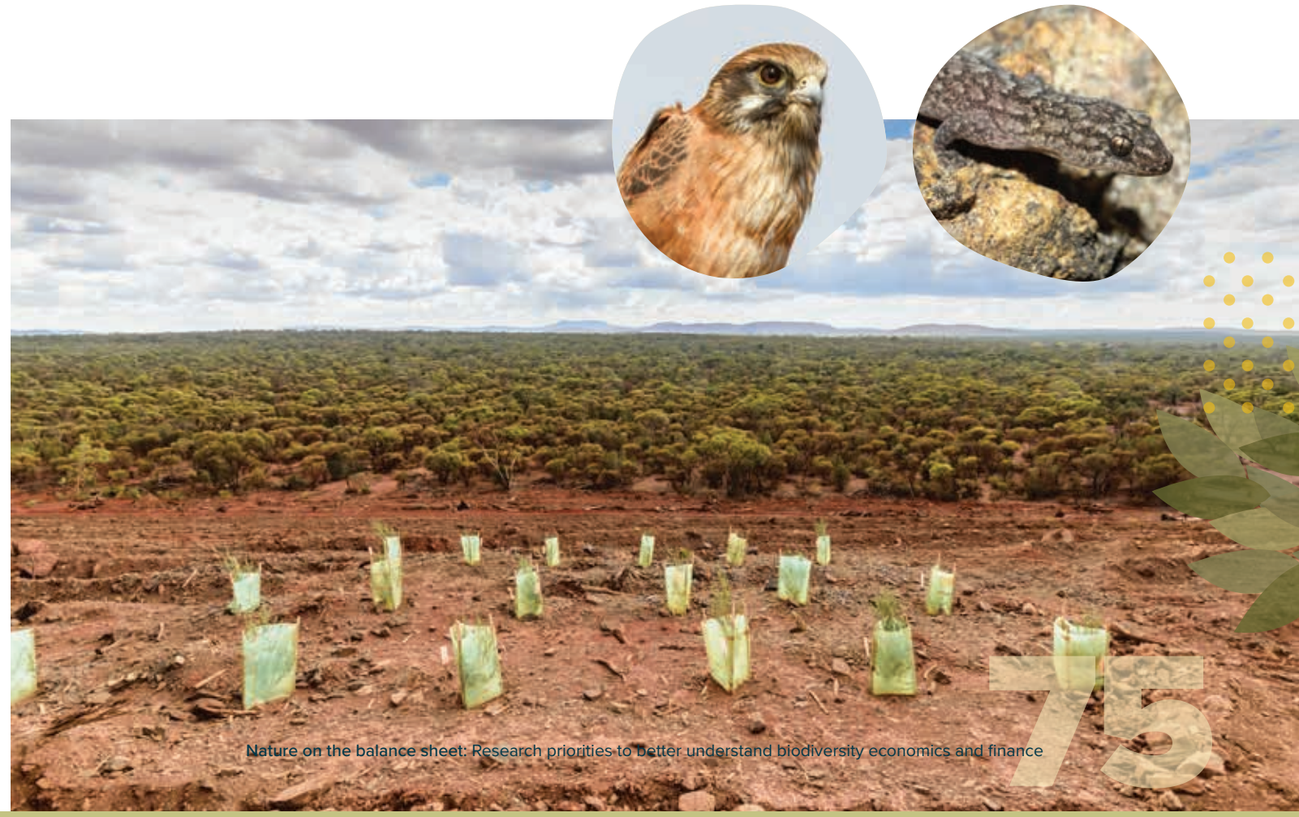
TABLE 27. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Market focus area in the resources sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
There would be understanding of the enhanced role of market-based approaches and technological innovations in establishing a functioning biodiversity market.	• Understand the role of market-based approaches to enhance demand for nature-positive products and establish a viable biodiversity market. • Identify the role of technology to improve efficiency of a biodiversity market.	Scope of the biodiversity credit or certificate market	1	• How can market-based approaches, such as biodiversity credits, help drive demand for biodiversity-positive products in the resources sector?
		Robustness of the biodiversity market	2	• How can biodiversity markets be made financially viable and scientifically credible for the resources sector?
		Role of technology in the biodiversity market	3	• What role can technological innovations (e.g. blockchain, digital platforms) play in improving transparency in biodiversity markets?

Focus area 8: Finance

TABLE 28. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Finance focus area in the resources sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
The state of biodiversity finance for Western Australia would be understood alongside biodiversity financing products and potential investors, and other stakeholders' expectations and risk profiles.	• Develop a business case for investing in biodiversity. • Incentivise local and Indigenous communities to restore biodiversity. • Understand the implementation challenges and impact of biodiversity-focused financial products. • Understand the biodiversity risk appetite of investors, businesses and governments.	Financial models to quantify biodiversity benefits	2	• What are the trusted methodologies to quantify the financial benefits of biodiversity actions that investors are increasingly demanding? • What are the barriers to success in translating biodiversity values or benefits into financially viable models for industry, especially when the regulatory framework is still developing or less clear? • How to demonstrate financial returns to investors to avoid projects with a perceived high biodiversity risk profile?
		Financial incentives	1	• What are the financial incentives for businesses to invest in biodiversity, to avoid the risk of stagnation in the sector? • What financial mechanisms can be developed to encourage private investment in biodiversity conservation?
		Biodiversity restoration capacity and stakeholder roles	3	• How to scale up biodiversity restoration with significant investment in training, capacity building and research while ensuring that methods are effective and sustainable? • What are the roles of local and Indigenous communities in driving biodiversity restoration, and how can they be incentivised?



Focus area 9: Practice

TABLE 29. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Practice focus area in the resources sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
Biodiversity considerations become an integral part of private and public decisions across the resources sector, supported by a robust decision-making process that aligns with other sectoral priorities.	• Understand the potential of mainstreaming biodiversity across the resources sector in Western Australia. • Assess the alignment of land use plans with conservation needs and social priorities. • Understand the challenges and potential solutions to integrating biodiversity considerations into business practices.	Synthesis of research evidence for decision-making	6	• How to consolidate existing biodiversity research to create a robust evidence base for decision-making? • What are the future-proofing policies (policy certainty) that will accommodate climate change and restoration goals, which will be essential to maintaining biodiversity in the long term?
		Balancing trade-offs and risks	5	• How to balance the tension between the practicality of implementing biodiversity conservation initiatives (resource constraints and other challenges) and achieving significant environmental outcomes? • How to balance investment between high-risk projects that can drive big changes and other projects that can help make biodiversity protection a normal part of everyday practice?
		Mainstreaming biodiversity	1	• How to mainstream biodiversity into broader environmental and economic goals to build a more resilient and sustainable environmental and economic system? • How to make biodiversity a mainstream consideration in decision-making, given the increased interest of investors in biodiversity?
		Forging alignment and avoiding misalignments	4	• How to avoid misalignment in biodiversity considerations between sectors (e.g. mining and agriculture), which could result in competing priorities and slowing progress? • How to build a coordinated approach to policy changes across levels of government (i.e. federal and state) to avoid confusion or unintended consequences for businesses and landholders?
		Sectoral coordination and effective engagement	3	• How to build effective engagement approaches among stakeholders across sectors to collaborate on biodiversity conservation goals? • How to shift from the current compliance-driven paradigm to proactive biodiversity stewardship within and across sectors?
		Land use practices and the need for systemic changes	2	• How to integrate land use practices and biodiversity conservation in the face of competing demands on land for social and economic priorities (e.g. agriculture, housing)? • What systemic changes are needed within industries to integrate biodiversity into long-term land use and development planning?

Services sector

Focus area 1: Learn

TABLE 30. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Learn focus area in the services sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
Research end-users and other stakeholders would develop a better understanding of the link between biodiversity and on-the-ground actions, and they would be able to articulate the need to integrate biodiversity into land use decisions.	• Understand the link between biodiversity and other activities to achieve nature-positive outcomes. • Understand ecological interactions and the economic implications of project activities. • Demonstrate pilot studies or proof-of-concept to attract interest and investment.	Ways to achieve nature-positive outcomes	3	• How to achieve nature-positive outcomes where human activities interact with biodiversity recovery in different contexts?
		Methods to improve biodiversity assessment	4	• How to improve biodiversity assessment using pilot projects based on eDNA or other new technologies?
		Successful pilots and case studies	1	• What evidence exists for successful pilots? • Are there successful case studies that can help attract both public and private sector investments in biodiversity conservation? • What are the economic and ecological benefits that can show proof-of-concept of biodiversity conservation to gain political support?
		Conservation awareness	2	• How to connect the public with biodiversity in effective ways to increase conservation awareness and actions?

Focus area 2: Measure

TABLE 31. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Measure focus area in the services sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
There would be improved measurement and access to biodiversity data from projects with the use of standardised and robust measurement metrics and methods.	• Develop fit-for-purpose biodiversity data metrics and measurement methods. • Improve biodiversity measurement approaches and tools by developing frameworks and guidance. • Develop access to, and insights from, new and existing biodiversity data to support decision-making.	Biodiversity data and accessibility	3	• How to address issues with the quality, accessibility and consistency of biodiversity data, which complicate biodiversity valuation? • What is the cost-effective way to establish baseline biodiversity data to facilitate assessment of the effectiveness of conservation efforts? • Is there a need for state-level vegetation mapping? If so, how to make it happen in a way that is accessible for decision-making?
		Biodiversity measurement (metric and unit of measure)	1	• What could be a standard metric to measure biodiversity? • How to build consensus on metrics to measure biodiversity? • How to standardise biodiversity metrics, especially at the bioregion level, which could facilitate better measurement, reporting and decision-making?
		Improving the consistency and quality of data	4	• How best to create and facilitate shared biodiversity data in Western Australia to make data more accessible and reliable? • How to improve the consistency and quality of biodiversity data, particularly with the use of emerging technologies like eDNA?
		Biodiversity data management	2	• What would be the best way to consolidate data across sectors? • How to minimise inefficiency in data generation and sharing? • What would be, or how do we develop, an interoperable system where the data generated by government and private entities are standardised, which will support measurement and reporting of biodiversity? • What are the challenges in reconciling observational data with inferred decision-making processes?

Focus area 3: Value

TABLE 32. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Value focus area in the services sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
The diverse values and valuation approaches of biodiversity would be understood by stakeholders and end-users in the services sector.	• Develop fit-for-purpose valuation methods to quantify biodiversity values. • Assess diverse values of biodiversity and integrate them into decision-making. • Identify effective ways to overcome measurement, valuation and communication challenges relating to biodiversity values.	Quantifying biodiversity values	2	• What is known about the intrinsic value of biodiversity (the importance of biodiversity on its own), and how to integrate it into decision-making? • What would be a consistent approach or framework to value biodiversity, if it is possible? • How to better quantify the value of urban nature and the impacts of biodiversity loss in cities?
		Integrating biodiversity values into financial and economic models	1	• How to overcome the challenges of integrating biodiversity valuation with financial systems — particularly when considering the cost of inaction (e.g. loss of ecosystem services)? • How to measure the intrinsic value of biodiversity and relational values of biodiversity, such as cultural or spiritual, which are often disregarded in economic models? • How to overcome challenges in measuring social and cultural values (e.g. public opinion, cultural importance) and making them actionable in financial and policy frameworks?
		Public perception of biodiversity value	3	• How to minimise the disconnect between public perception of biodiversity value and the actual on-the-ground actions required? • What are the effective ways to increase awareness of the relational and social value of biodiversity to shift public perception? • What media and community engagement strategies, like place-based approaches to biodiversity valuation, could raise the profile of biodiversity issues?

Focus area 4: Account for

TABLE 33. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Account for focus area in the services sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
The contributions of biodiversity and nature across the services sector would be accounted for based on an interoperable and scalable natural capital accounting framework.	• Develop and pilot a natural capital accounting framework to document the contribution of biodiversity and nature for different aspects of the services sector. • Develop tools or frameworks to integrate biodiversity and nature at varying scales into private and public sector decisions-making.	Consistent and interoperable frameworks to account for biodiversity and nature	2	• What interoperability mechanism would work to connect different natural capital accounting frameworks in practice to account for biodiversity and nature for the relevant services sectors? • Is there a scope for a common natural capital accounting framework? If not, how to compare across different frameworks to develop consistent information?
		Inclusion of Indigenous perspectives in accounting for biodiversity and nature	1	• How to capture Indigenous and local knowledge in the natural capital accounting process, which is essential but often overlooked? • How to incorporate cultural and social perspectives in biodiversity accounting to develop a holistic understanding of biodiversity and nature?
		A consistent reporting framework	3	• What would be a consistent approach or framework for biodiversity and nature reporting purposes? • What would be a transparent, standardised and cost-effective reporting mechanism for biodiversity impacts and financial returns of the services sector and businesses that could attract more investments?
		A regional approach or framework of accounting for biodiversity and nature	4	• What type of regional approach to natural capital accounting could be useful for Western Australia to provide a foundation for standardised, government-supported data across sectors, making it more cost-effective? • How to align any regional approach to natural capital accounting to streamline data collection, reporting and financing with the national and global targets (e.g. TNFD)?

Focus area 5: Enabler

TABLE 34. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Enabler focus area in the services sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
An enabling environment would be developed for enhanced cross-sector collaborations and integration of Indigenous knowledge systems on biodiversity into relevant policy frameworks.	• Strengthen collaboration with government, industry and key stakeholders to improve and develop cohesive and holistic policies to enhance conservation. • Create an enabling environment for behavioural changes, and to link biodiversity with social and economic returns. • Create enabling conditions and integrate Indigenous knowledge into the biodiversity or natural capital accounting framework.	Need for cohesive and holistic policy	1	• How to address biodiversity in a cohesive manner by avoiding fragmented policies that focus on specific sectors like mining? • How to find ways to develop and promote policies that encourage co-investment and allow for flexible mechanisms, such as hybrid offsetting models or green bonds, to support nature-positive initiatives?
		Ways to integrate Indigenous knowledge	2	• What are collaborative and culturally appropriate ways to integrate Indigenous knowledge into biodiversity frameworks (measurement, valuation, accounting)?
		Linking biodiversity outcomes with social and economic outcomes	3	• What are existing approaches or new methodologies that link biodiversity improvements directly to social and economic outcomes?
		Fostering collaboration in sharing the risk and making natural capital accounting actionable	4	• How to secure commitments from both government regulators and large corporations for biodiversity assessment and natural capital accounting? • How can government and the private sector collaborate to make the natural capital accounting frameworks actionable? • Can government-backed concessional loans and risk-sharing mechanisms lower the barriers to private sector participation in conservation?
		Behavioural change for public support	5	• What types of social nudges and educational campaigns for biodiversity and nature can drive behavioural change and increase public support for policy shift? • How to increase the adoption of biodiversity conservation policies where the dominant focus is on industries like mining, and there is societal resistance to changing long-standing practices?

Focus area 6: Economics

TABLE 35. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Economics focus area in the services sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
The cost of inaction and the economic benefits of biodiversity and nature-friendly planning would become clearer to knowledge end-users and stakeholders.	• Quantify the costs of inaction to biodiversity loss. • Estimate the benefits of biodiversity and nature-positive planning and actions from economic as well as other perspectives.	Estimating the cost of biodiversity loss or the cost of inaction	1	• What is the cost of biodiversity loss or not protecting biodiversity, in terms of lost ecosystem services (e.g. coastal protection, flood regulation) and other societal benefits for relevant services sectors? • What is the cost of inaction, such as loss of pollinators and pollination services in agriculture, to relevant services sectors?
		Finding ways to integrate biodiversity into economic planning and decision-making	2	• How to develop a financial value proposition for biodiversity to integrate it into economic planning and decision-making? • What would be the best way to demonstrate the economic, ecological and social benefits of nature-positive planning?

Focus area 7: Market

TABLE 36. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Market focus area in the services sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
There would be a sound understanding of the biodiversity market and the risks of biodiversity loss to different sectors of the economy.	• Understand the risks of biodiversity loss. • Understand the prospects of the biodiversity market.	Risk of biodiversity loss to sectoral markets	1	• What are the risks of biodiversity and nature loss to relevant services sectors in the economy? • What are the risks of continued biodiversity loss to relevant services, particularly in sectors like agriculture where pollination and soil health are vital?
		Demand and supply prospects of biodiversity credits or certificate markets in relevant services sectors.	2	• What are the demand and supply-side factors in biodiversity credit or certificate markets from relevant service sector perspectives? • What would be the best way to engage in the nature repair market as a service provider, landholder or Indigenous community?

Focus area 8: Finance

TABLE 37. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Finance focus area in the services sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
The state of biodiversity finance mechanisms and instruments would be better understood alongside potential opportunities for new products and instruments to bridge financing gaps.	• Assess existing biodiversity financing mechanisms and explore potential new financing mechanisms and instruments. • Understand the implementation challenges and ways to address financing gaps. • Find ways to price biodiversity risk for financial products.	Ways to address the biodiversity finance gap	3	• What would be a negotiated outcome between policymakers, businesses and investors to address the biodiversity finance gap? • What financial and policy incentives would drive private and public investment in biodiversity conservation?
		Holistic approach and robust financial instruments	1	• What would be an integrated approach to finance biodiversity conservation as opposed to existing fragmented ways? • What type of robust financial instruments and tools, such as biodiversity credits, would help bring in capital for long-term biodiversity conservation?
		Potential opportunities to increase biodiversity financing	5	• What are the relative merits and scope of biodiversity financing instruments for Western Australia (e.g. green bonds, biodiversity credits, and ecosystem service payments)? • What is the scope for bundling carbon and biodiversity credits and applying instruments, such as green bonds and biodiversity credits, to drive investment in conservation and sustainable land management practices? • What new financial instruments, such as biodiversity-based insurance products, can provide the necessary funding for biodiversity initiatives? • What are the potential alternatives to traditional biodiversity offsetting, such as hybrid models or region-specific approaches?
		Pricing biodiversity risks	4	• How to price biodiversity risks and integrate them into nature-related financial disclosures of businesses?
		Finding ways to develop financing certainty	2	• How to minimise financial uncertainty to promote investments and nature-positive approaches in biodiversity conservation? • What are potential and effective mechanisms to involve both the public and private sectors in biodiversity funding to build sustainable biodiversity financing mechanisms? • What can be learned from insurance companies that can provide valuable insight into how biodiversity risks (e.g. species extinction, habitat loss) can be priced into financial products? • How to develop flexibility into biodiversity financing mechanisms to suit local contexts?

Focus area 9: Practice

TABLE 38. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Practice focus area in the services sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
Biodiversity considerations become an integral part of private and public decisions, alongside coordinated policies and practices.	• Understand the potential of mainstreaming biodiversity across various services sectors. • Find ways to incorporate the costs of biodiversity loss into public and private decision-making. • Understand ways to align and improve policy and practice across jurisdictions.	Ways to factor in the cost of biodiversity loss in decision-making	1	• What are the tools or approaches to internalising the cost of biodiversity loss into business or government decisions within the relevant services sector? • How to effectively quantify and integrate public perception of biodiversity values into the decision-making process?
		Harmonising and aligning jurisdictional policies	2	• How best to align local, national and international biodiversity targets to achieve expected outcomes within the services sector? • What are effective ways to harmonise jurisdictional policies (e.g. national and state) with a commitment to integrating biodiversity into broader economic and financial systems?
		Making biodiversity a mainstream issue	3	• How to operationalise actions from both the public and private sectors engaged in the services sector so that biodiversity is considered a mainstream issue?

Financial sector

Focus area 1: Learn

TABLE 39. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Learn focus area in the services sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
Research end-users and other stakeholders would develop a better understanding of the link between biodiversity, its benefits and on-the-ground actions.	• Understand the link between biodiversity and its societal benefits (e.g. health). • Understand new concepts in biodiversity management. • Generate evidence for public policy.	Clarity on evolving concepts	1	• Clarify the meaning of terms such as 'no net loss' and 'net gain' for financial markets to avoid confusion in policy and implementation?
		Understanding ecosystem tipping points	2	• What is known about ecosystem tipping points in Western Australia to avoid irreversible biodiversity loss with cascading effects on its biodiversity and economy?
		Public awareness of the benefits of biodiversity	4	• How effective are educational activities in clarifying the role of biodiversity in human well-being? • How to run effective awareness-raising activities to improve biodiversity outcomes?
		Evidence for public policy purposes	3	• How effective would large-scale longitudinal surveys be on public attitudes to biodiversity to inform relevant public policy? • What is known about sub-sovereign treasury functions in Australia to approach biodiversity from a financial perspective (consider using New South Wales as a starting point)?

Focus area 2: Measure

TABLE 40. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Measure focus area in the services sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
There would be improved measurement, monitoring and sharing of biodiversity data for better decisions and biodiversity outcomes.	• Establish a biodiversity baseline and improved data sharing arrangements for better decisions for the financial sector. • Develop access to, and insights from, new and existing biodiversity data to support decision-making.	Data streamlining and potential opportunities	2	• How to measure ecosystem tipping points, which is crucial but underdeveloped? • How best to aggregate existing fragmented biodiversity data and apply machine learning to create actionable insights and track biodiversity changes more effectively?
		Establishing a biodiversity baseline and monitoring to aid decision-making	1	• How to create a clear and independent baseline for biodiversity, using available data from Western Australian agencies and others like the the Australian Bureau of Statistics? • What are the challenges to accurately measuring biodiversity and establishing clear baselines?
		Mechanisms for greater sharing, aggregation and better use of existing biodiversity data	3	• In the current context (lack of integration, privacy concerns, regulatory restrictions), how best to use existing environmental and biodiversity data? • What would be the best way to share data by data custodians (e.g. mining companies) for better and effective decisions in the absence of clear privacy policy around environmental data and concerns about data misuse?

Focus area 3: Value

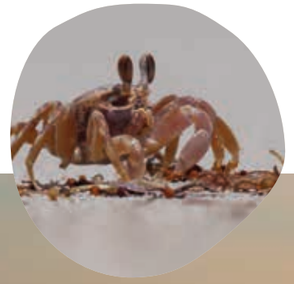
TABLE 41. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Value focus area in the services sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
The research program end-users and stakeholders would have a better understanding of biodiversity values and valuation approaches to assess biodiversity risks.	• Understand biodiversity and nature values from different perspectives. • Explore biodiversity valuation approaches to understand tipping points and price risks.	Understanding biodiversity values and valuation	1	• What is the true value of biodiversity from a financial sector perspective? • How to value ecosystem tipping points? • What are the spiritual and cultural values of biodiversity from Indigenous perspectives?
		Estimating biodiversity risks	2	• What are available approaches to price biodiversity risks to businesses? • How to cost-effectively integrate biodiversity risks into economic modelling?

Focus area 4: Account for

TABLE 42. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Account for focus area in the services sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
The contributions of biodiversity and nature to the financial sector would be accounted for using the relevant natural capital accounting framework while also addressing biodiversity and nature-related financial risks.	• Develop or adapt a natural capital accounting framework that fits well with the financial sector and Western Australia's context. • Develop tools or frameworks to manage biodiversity and nature risks in the financial sector.	Developing a natural capital accounting framework	1	• What type of natural capital accounting framework would work best for Western Australia's unique contexts? • How to follow or adapt the ecosystem accounting framework developed by the Australian Bureau of Statistics or the United Nations' System of Environmental-Economic Accounting for Western Australian contexts? • What natural capital accounting frameworks would align best with global environmental, social and governance standards for WA?
		Developing a biodiversity and nature risks management framework	2	• What would be a robust risk management framework for the financial sector that includes biodiversity risks? • How to provide clear guidance for businesses and government agencies on biodiversity and nature-related financial risks to help them make informed decisions? • How can nature-based solutions reduce financial risks and provide long-term benefits?



Focus area 5: Enabler

TABLE 43. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Enabler focus area in the services sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
An enabling environment would be enhanced through collaboration between the private sector and the government through developing policy clarity and appropriate risk mitigating strategies.	• Find appropriate ways or frameworks to reduce biodiversity-induced financial risks to the private sector. • Develop policy certainty and enhanced collaboration by framing biodiversity issues appropriately to the financial sector.	Skill and capacity gaps	4	• How to increase government funding and capacity to support biodiversity measurement, valuation and policy implementation?
		Biodiversity and nature risks to the private sector	3	• How to align government policies with private sector needs, especially in terms of incentivising biodiversity conservation or sharing risks? • How to develop a unified approach to understanding and managing biodiversity risks within corporations and/or government agencies? • What would be the best approaches to minimising regulatory, reputational and financial risks for companies that may arise from biodiversity and/or nature?
		Framing the biodiversity issue	2	• How best to educate the public and industry about the value of biodiversity and ecosystem services to shift the market and policy context towards more sustainable practices? • How best to frame or develop a case for biodiversity protection as a strategic advantage to businesses to incentivise them to participate in conservation actions? • Would framing biodiversity conservation as a form of insurance against climate and environmental risks appeal to both the public and businesses for cost-effective and proactive conservation strategies for the future?
		Policy certainty	1	• How to develop policy clarity and certainty on key biodiversity concepts to initiate effective biodiversity actions to avoid reputational risk or damage?

Focus area 6: Economics

TABLE 44. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Economics focus area in the services sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
The economic benefits of biodiversity, the cost of inaction to biodiversity loss, and the risk appetite of the government would become clearer to knowledge end-users and stakeholders.	• Understand the link between economic benefits and biodiversity values. • Estimate the costs of inaction to biodiversity loss. • Assess the biodiversity risk appetite of the government.	Biodiversity value and economic outcomes	2	• How to integrate biodiversity values into economic and policy decisions? • What are the established links between biodiversity, its value and economic outcomes that show how protecting biodiversity and nature contributes to economic outcomes? • How to enhance public and government understanding of biodiversity as a valuable public good that affects policy and financial investment?
		Costs of biodiversity loss	1	• How to avoid failure to conserve biodiversity in Western Australia that could risk or increase long-term social and economic costs arising from different sources, including reduced ecosystem services (e.g. pollination, water filtration)? • What strategies would address biodiversity decline and enhance economic opportunities, especially in financial sectors?
		Biodiversity risk appetite of the government	3	• What are the key components of the biodiversity risk appetite of the government with a focus on different aspects of biodiversity? • How to find areas for improvement or retrofit in the existing biodiversity governance contexts?

Focus area 7: Market

TABLE 45. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Market focus area in the resources sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
There would be a better understanding of biodiversity and nature repair markets among research end-users and key stakeholders.	• Understand effective mechanisms for the offset market. • Understand the prospects and functioning of the nature repair market.	Effective offset market	2	• What are the challenges in ensuring biodiversity offsets are effective while limiting the concerns over future tenure security and fraud?
		Nature repair market	1	• How can the nature repair market be made financially viable and scientifically credible for different sectors of the economy? • What is the demand and supply of biodiversity certificates for the nature repair market in general, and particularly for lands managed by Indigenous communities?

Focus area 8: Finance

TABLE 46. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Finance focus area in the services sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
The state of biodiversity finance, financial products and instruments and their effectiveness would be better understood to bridge the biodiversity financing gaps.	• Assess existing biodiversity financing products and instruments to achieve greater biodiversity outcomes. • Understand the government's biodiversity risk appetite to design new financial products. • Provide incentives for financial institutions to focus on biodiversity or environmental outcomes.	Closing the biodiversity finance gap and financial products	1	• How to address the biodiversity finance gap required for long-term biodiversity protection? • How to fill the gap in the lack of adequate financial products and instruments in financial systems (insurances, banking, asset management etc.) to reward pro-conservation behaviour? • What existing financial product (e.g. concessional loan, green bonds etc.) is most effective for conservation and in what context? • What new financing products or models (e.g. green bonds, biodiversity credits) would create a sustainable funding stream for conservation efforts?
		The government's biodiversity risk appetite	3	• What is the government's risk appetite regarding biodiversity loss?
		Financial institutions' focus on biodiversity or environmental outcomes	2	• How to accelerate the focus of financial institutions on biodiversity or environmental outcomes (e.g. stakeholders like investors, banks and insurers) to benefit conservation?
		Effective use of biodiversity or environmental data to enhance investment	4	• How to use environmental data for social licence and reputational benefits to drive investment and public support for biodiversity projects?

Focus area 9: Practice

TABLE 47. Outcome, objectives, knowledge gaps and their ranking, and example research questions for the Practice focus area in the services sector

Outcome	Objectives	Knowledge gaps	Ranking	Example research questions
Biodiversity policies are improved, along with enhanced collaboration among stakeholders, and biodiversity becomes an integral part of financial decision-making.	• Assess biodiversity policies for improvements and updates so that biodiversity can be mainstreamed across various financial sectors to achieve long-term goals. • Understand the biodiversity and nature-related risk appetite of the financial sector. • Develop and foster stronger collaborations.	Policy updates	1	• How to improve and effectively apply current environmental policies to incentivise actions (e.g. conservation actions)? • What kind of financial policy modification would focus on long-term environmental goals? • How to develop coherence between policy decisions for immediate economic goals (e.g. growth, inflation) and long-term sustainability or conservation goals? • What policy framework would sufficiently manage and aggregate financial and biodiversity data effectively for better decision-making? • How best to use the available opportunity to revise existing policies and create new ones (in Western Australia) that prioritise long-term biodiversity conservation by integrating biodiversity and nature into economic planning?
		Biodiversity risk appetite of the financial system	2	• What is the meaning and extent of the risk appetite for biodiversity in the financial sector/system? • How does the lack of a clearly defined biodiversity risk appetite result in a lack of policy or frameworks to manage this risk effectively? And what can be done about it?
		Fostering collaboration	3	• How to build stronger collaborations between government, businesses and investors to align their actions around biodiversity protection and financial risk management?

5. Research program framework

Research program structure

The overall aim of the Biodiversity Economics and Finance Research Program is to contribute to its vision, while fulfilling the identified objectives and achieving desirable outcomes.

The framework components of the research program are presented in Figure 6 as a scaffolding diagram, which shows how the research questions are linked to the program's vision, objectives and outcomes. The framework components are illustrated and described in Figure 7 and consist of two main themes – Understanding and Mainstreaming – and nine focus areas (Box 7). These research focus areas are the key elements of the research program framework, which are: Learn, Measure, Value, Account for, Enabler, Economics, Market, Finance and Practice. The first four focus areas belong to the Understanding theme and the latter five belong to the Mainstreaming theme.

Knowledge gaps were identified and ranked for each focus area of the research program for overall prioritisation as well as sectoral prioritisation for the four sectors – primary production, resources, services and financial. For each knowledge gap, multiple research questions were identified. These questions were provided as examples but not ranked during the prioritisation process. The relationships between focus areas, knowledge gaps, and research questions are illustrated in Figures 8a and 8b.

BOX 7. Nine focus areas of the Biodiversity Economics and Finance Research Program

Learn focuses on knowing the concepts, importance and state of biodiversity and nature's services.

Measure assesses the state of biodiversity and nature based on data, methods and measurement metrics.

Value refers to different types of values placed by individuals, communities and society on the type and extent of biodiversity and nature's services.

Account for relates to quantifying the physical amount (extent and condition) and monetary or other forms of values of the stocks and flows of biodiversity and nature for a specified period.

Enabler refers to the conditions required for biodiversity and nature's services to become an integral part of private and public deliberations, considerations and activities.

Economics relates to quantifying and analysing the direct and indirect benefits and costs to households, business and society that are associated with conservation or loss of biodiversity and nature.

Market characterises the mechanism by which biodiversity units or nature's services are traded in the market place, including their price and quantity, and focuses on the demand and supply sides of biodiversity units and nature's services.

Finance relates to the concept of biodiversity and nature as an investable asset and the ways (tools and instruments) to finance their conservation and management for private and public benefits.

Practice refers to applying or integrating biodiversity and nature's services into economic and financial decisions and policy-making by the private and public sectors.

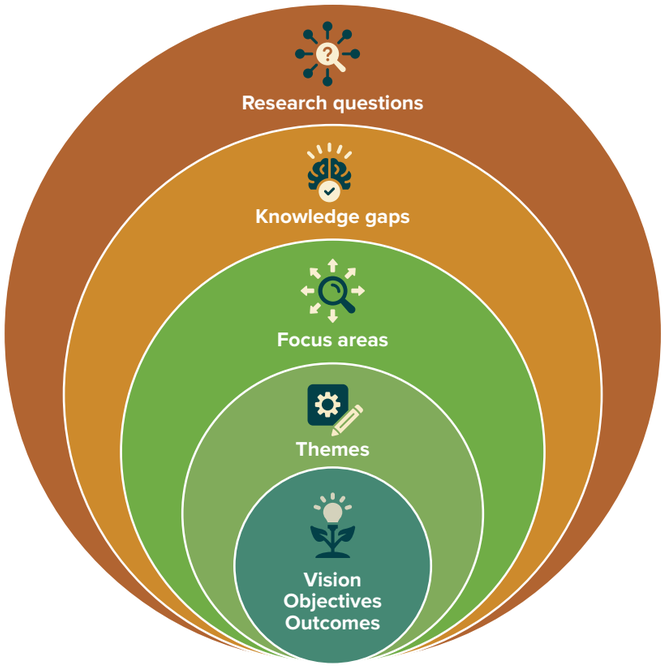


FIGURE 6. Scaffolding of the Biodiversity Economics and Finance Research Program: vision, objectives and outcomes to research questions

FIGURE 7. Biodiversity Economics and Finance Research Program framework: themes and focus areas

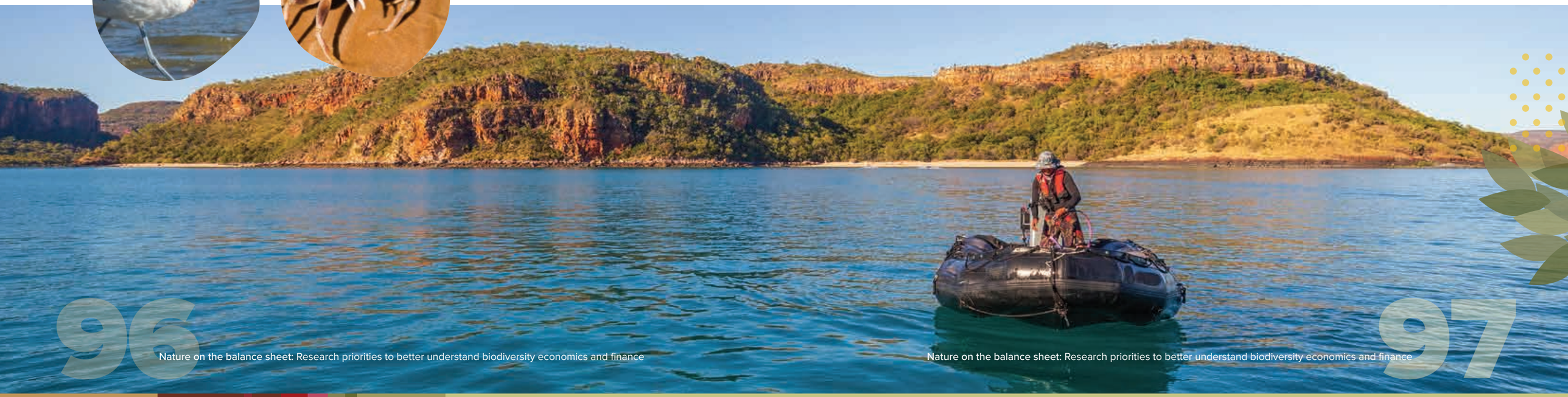


FIGURE 8a. The relationships between focus areas, knowledge gaps, and research questions. KG = Knowledge gap, RQ = Research question

FOCUS AREA 1: Learn		
KG 1: Link between biodiversity and business performance (financial outcomes)	RQ 1	What are the site-specific biodiversity risks that are associated with corporate-level business risks?
	RQ 2	What are the biodiversity risk profiles of different corporations or businesses (private sector)?
	RQ 3	How to improve understanding of business on the attribution of biodiversity outcomes (hard to know what actions contribute to which results)?
KG 2: Practical guidance to integrate biodiversity into land management decisions	RQ 1	What are the practical guidelines for landholders (farmers, pastoralists) on what they can achieve from natural capital and biodiversity in their farms?
	RQ 2	What do landholders know about farm activities and their interactions with the surrounding environment (and vice versa) in terms of economic output?
	RQ 3	What is known about the relationship between the stock of biodiversity (nature) and farm productivity?
KG 3: Meaning and practical implications of key concepts	RQ 1	What do concepts like no net loss and net gain mean for financial markets?
	RQ 2	What are the trading units for biodiversity markets?
	RQ 3	What does the concept of counterfactual mean in biodiversity assessments in various contexts?
KG 4: Link between activities, ecological interactions, and resultant biodiversity outcomes	RQ 1	How are land use activities, ecological interactions and economic-ecological outputs connected?
	RQ 2	What is known about the cause-effect relationship (response function) of any actions and resultant biodiversity outcomes in the farming context?
	RQ 3	How does the cumulative (landscape level) effect operate and become apparent in the action at Site A on the outcomes at Site B and vice versa?
KG 5: Stakeholders' motivations and information needs for biodiversity	RQ 1	What motivates stakeholders (government, regulators, industry, financial institutions, communities) to invest in nature or biodiversity?
	RQ 2	What are the value propositions of landholders to engage in natural capital accounting or biodiversity markets?
	RQ 3	What are biodiversity-related information needs of knowledge end users and how do they use that information?

FIGURE 8b. The BEF program framework elements: The illustration of the relationship between focus area, knowledge gap (KG), and research question (RQ) using the Learn focus area as an example

6.

Research program implementation

The successful implementation of the Biodiversity Economics and Finance Research Program requires a governance mechanism, substantial funding and adequate risk management in different aspects of program delivery. Some of the knowledge gaps prioritised in this program are common to, or have significant overlap with, WABSI's other research programs, and will require a coordinated approach to implementing the research programs.

Funding strategy

A range of funding strategies would be adopted to implement the research program, from competitive bids to philanthropic sources. The following schemes may be sources of funding.

Australian Research Council Linkage Projects

The Australian Research Council (ARC) Linkage Projects scheme promotes collaboration and research between higher education organisations and industry end-users to support internationally competitive research projects that benefit the organisations and Australia. Projects must include at least one partner organisation that contributes cash or in-kind support. The total contributions from partner organisations must at least match the total funding requested from ARC. The scheme provides project funding between AU$50,000 and AU$300,000 per year for two to five years.

ARC Industrial Transformation Training Centre

The Industrial Transformation Training Centre scheme provides funding for research partnerships between universities and industries. The training centre supports higher degree by research and postdoctoral candidates to undertake industrial training. It strengthens the capabilities of industries and research end-users in identified industrial transformation priority areas.

Cooperative Research Centres Projects

Cooperative Research Centres Projects (CRC-P) grants fund up to three years of industry-led research to solve industry problems through matched funding ranging from AU$100,000 to AU$3 million. The scheme requires a collaboration between two Australian industry organisations (with at least one small to medium enterprise) and one Australian research organisation. The funding can be used for new research, proof-of-concept activities, pre-commercialisation of research outcomes, industry-focused education and training, and activities related to information sharing and communications about the research.

Biodiversity economics and finance consortium

There is an opportunity to establish a research consortium comprising research institutions, government departments, industries and end-users of research that would seek research funding from the private and public sectors in Western Australia. In particular, such a consortium could leverage industry contributions for a specific research priority area (or research project) with contributions from government departments or research institutions to implement the prioritised research program. This funding strategy could also be part of a governance approach to implement priority research in biodiversity economics and finance.

Direct or pooled industry investment

Direct or pooled industry investment presents an opportunity to support biodiversity economics and finance research in Western Australia, which can be targeted to overcome immediate research needs or knowledge gaps faced by industry. As industries are increasingly held accountable for their environmental footprints, these investments offer potential financial returns and help industries align with sustainability goals, fulfil environmental, social and governance commitments, and contribute to biodiversity conservation.

National Environmental Science Program

The National Environmental Science Program Phase 2 (NESP2) has allocated AU$47.08 million for the Resilient Landscapes Hub between 2021 and 2027. The hub is hosted at The University of Western Australia and provides research funding to support management of Australia's terrestrial and freshwater habitats to develop and maintain resilient, sustainable and productive landscapes. Research funding areas are environmental monitoring systems and decision support tools, and natural capital valuation, among others. This hub or a similar funding arrangement in the future through the NESP would be another potential funding source for some of the identified research priorities.

Philanthropy and strategic partnerships

Strategic partnerships between land managers, NRM groups, non-government organisations, financial service providers (banks, accounting firms) and philanthropic organisations are options for co-investing in complementary research. NRM groups (such as South Coast, South West, Wheatbelt, Perth, Rangelands and Northern Agricultural Catchments Council), not-for-profit groups (such as Greening Australia, Gondwana Link, Australian Wildlife Conservancy and Indigenous ranger groups) and various grower groups in Western Australia present well-aligned strategic partnership options.

Governance

The successful delivery of prioritised research is dependent on an appropriate governance structure. The WABSI research program development pathway builds in the establishment of a steering committee to deliver prioritised research programs. The committee will comprise key stakeholders, researchers, Indigenous scholars, and at least one representative from the regulatory sector to ensure that research outcomes are consistent with policy objectives. While WABSI will provide program support, the committee that will oversee the implementation of the prioritised research will be independent.

The primary role of the steering committee is to:

- drive project development, ensuring projects are well integrated and aligned with the research prioritisation to achieve outcomes
- pursue relevant funding opportunities for prioritised projects
- assist in the scoping of projects and ensure intended outcomes meet the requirements of the knowledge end-users
- ensure the science being delivered is of a high standard and without duplication of research effort
- ensure outcomes are able to be translated effectively to all end-users of the knowledge to encourage adoption of research findings
- maintain the research program plan, ensuring it is up to date and best reflects the current end-user needs and research capability
- align research activities to relevant state and Commonwealth plans, strategic priorities and objectives.

7.
Emerging research

Biodiversity economics and finance is an emerging research field. In Western Australia, available biodiversity economics research has been primarily focused on species and ecosystem valuation (Subroy et al. 2018), biodiversity offsets (May et al. 2017), conservation auction (Schilizzi and Latacz-Lohmann 2007), and landscape auction design (Gole et al. 2005, White and Burton 2010). Research in the field of natural capital accounting (Fairbrass et al. 2020, Maybee et al. 2023a, Pantelic et al. 2023) and biodiversity finance is at early stages in Western Australia. Pilot studies in natural capital accounting with a focus in farming (Tuckett et al. 2024) and mining (Maybee et al. 2023b, O'Grady et al. 2023) have been started, and have generated some preliminary results.

There is no single institution that covers the entire remit of biodiversity economics and finance related research in Western Australia. The following organisations directly and indirectly contribute to biodiversity economics and finance related research in Western Australia.

Department of Water and Environmental Regulation

The Department of Water and Environmental Regulation (DWER) has a mission to protect environmental values while pursuing sustainable development in Western Australia. It provides independent advice to the Environmental Protection Authority to assess the environmental impacts of development projects. The Nature program within DWER's Climate and Sustainability portfolio is closely linked to research in biodiversity economics and finance. Its research in nature and biodiversity focuses on supporting environmental assessment and compliance so that development projects have minimal impact on the natural environment. It also conducts research to understand the health and productivity of ecosystems.

DWER's work related to implementation of native vegetation policy, reform of environmental offsets (in light of the concerns on offsets supply and offsets performance), and management of the Pilbara Environmental Offsets Fund are loosely linked to WABSI's Biodiversity Economics and Finance Research Program.

Department of Biodiversity, Conservation and Attractions

The Department of Biodiversity, Conservation and Attractions (DBCA) works with the community to ensure that Western Australia's environment is valued, protected and conserved. It promotes biodiversity and conservation, and contributes to people's well-being through sustainable management of species, ecosystems and land. Two of the department's core purposes (Discover and Conserve) align directly with WABSI's Biodiversity Economics and Finance Research Program (DBCA 2024). The key aspects of those purposes are:

- use world-recognised knowledge to build and share biodiversity knowledge to support evidence-based management
- collate, manage and share data to support effective decision-making and conservation
- develop adaptive management tools to promote ecosystem resilience to the impacts of climate change and other threats
- conserve, restore and manage plants and animals, ecosystems and landscapes using world-recognised science and best practice management
- manage threats to maintain and enhance biodiversity and cultural values
- maintain and enhance sense of place and associated natural, cultural, heritage and landscape values.

The DBCA's research focuses on conserving habitat, species and ecological communities, and has strategic and operational partnerships with other government departments, research institutions, communities and industries (DBCA 2024). Examples include conducting biological and environmental surveys, managing threats (invasive animals and plant diseases) and maintaining the state's biodiversity information through the Dandjoo Biodiversity data sharing platform, which has over 2.9 million records (DBCA 2024).

Department of Primary Industries and Regional Development

The research and development work of the Department of Primary Industries and Regional Development (DPIRD) focuses on sustainable development of Western Australia's regions and primary production sectors (agriculture, aquaculture, food and fisheries) with the stewardship of land and aquatic resources (DPIRD 2024). It uses a protect, innovate and grow approach in its operations (DPIRD 2024). DPIRD's work in NRM, soil and land conservation, regional development (including Indigenous communities' development) and carbon farming programs are linked to WABSI's Biodiversity Economics and Finance Research Program. To fulfil the state's net zero emissions by 2050 target, DPIRD has developed its sectoral emissions reduction strategy and is working on developing a sectoral adaptation plan. DPIRD also conducts industry economic analysis for the primary industries and food sector (DPIRD 2024). Research in biodiversity economics could be closely linked to the synergies and trade-offs of considering biodiversity and natural capital within the operations of primary industries.

Department of Planning, Lands and Heritage

The following work of the Department of Planning, Lands and Heritage (DPLH) (DPLH 2024) has some links to the Biodiversity Economics and Finance Research Program:

- Establish five million hectares of new national parks in collaboration with the DBCA under the Plan for Our Parks initiative.
- Develop carbon farming opportunities and carbon farming methods in collaboration with DPIRD and other government departments to meet the state's net zero carbon emissions by 2050 goal.

Commonwealth Scientific and Industrial Research Organisation

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) has a strong research focus in a range of fields that are linked to biodiversity economics and finance. In implementing WABSI's research program, complementary areas of research should be prioritised while avoiding duplication. In particular, the following CSIRO research programs are closely linked:

- research projects under the Valuing Sustainability Future Science Platform, and particular natural environment programs (such as land, biodiversity and ecosystem) that help to maintain integrity of the environment and ensure sustainable use of natural resources (Urzedo and Robinson 2023, Urzedo et al. 2024)
- research in natural capital accounting to assess and account for natural capital and ecosystem assets, such as water, soil, plants and animals, so that nature is considered in decision-making (McLeod et al. 2021, Smith et al. 2023)
- research in biodiversity status and trend, habitat condition assessment and environmental monitoring to develop better understanding of species and ecosystems for better management (Williams et al. 2021, Mokany et al. 2022)
- research in financial opportunities and risks for nature-positive aspirations (Luxton et al. 2024).

Other Western Australian organisations

Non-government organisations

Natural Resource Management organisations: The NRM organisations manage unique landscapes and biodiversity (flora, fauna and ecosystems) of Western Australia in close collaboration with local and Indigenous communities. There are seven such organisations in Western Australia: Perth NRM, Wheatbelt NRM, South Coast NRM, South West NRM, Peel–Harvey Catchment Council, Northern Agricultural Catchments Council and Rangelands NRM. These organisations are actively engaged in piloting natural capital accounting in farms (e.g. Perth NRM) (Tuckett et al. 2024), developing regional ecosystem accounts (e.g. Wheatbelt NRM) (Richards et al. 2023), and progressively working towards developing landscape-level natural capital accounting projects (e.g. South Coast NRM).

Greening Australia: Greening Australia is a not-for-profit organisation dedicated to restoring Western Australia's diverse landscapes and protecting biodiversity to benefit communities, economies and nature. It works closely with landholders to grow habitats and food sources for endangered species. Its restoration and nature-based solutions programs contribute to restoring and protecting Western Australia's biodiversity. This includes its collaborative works with local communities, industry and government departments in the Pilbara region (Heydenrych and Parsons 2018).

The Conservation Council of Western Australia: The Conservation Council of WA (CCWA) is a not-for-profit conservation and environment organisation. It works closely with communities, government, Traditional Owners, industry and media to protect Western Australia's natural environment for sustainability. The council is an advocate for nature and influences conservation policy in Western Australia.

Bush Heritage: Bush Heritage is a not-for-profit conservation organisation that works throughout Australia. Its aim is to protect and conserve the land, flora and fauna through buying and protecting land, and through partnerships with Indigenous communities, farmers and other landholders, corporate agencies, research institutions and regional partners such as Gondwana Link to deliver landscape-scale conservation outcomes. It has already protected over 4.1 million hectares of land in Western Australia.

Australian Wildlife Conservancy: The conservancy protects Australia's unique wildlife through science, innovation and partnerships to restore species and habitats across the country. In Western Australia, it works at Charnley River-Artesian Range Wildlife Sanctuary, Dambimangari Partnership Area, Faure Island Wildlife Sanctuary, Karakamia Wildlife Sanctuary, Mornington-Marion Downs Wildlife Sanctuary, Mt Gibson Wildlife Sanctuary, Tableland Partnership Area, Wilinggin, Paruna Wildlife Sanctuary and the Yampi Sound Training Area.

Universities

The University of Western Australia (UWA): The Centre for Environmental Economics and Policy at UWA conducts research in a wide range of environmental issues, including biodiversity conservation. Research into environmental valuation, particularly assessing public preferences and values of biodiversity (threatened flora, fauna and ecosystems) and environmental markets, are directly relevant to this research program.

Curtin University: The Trace and Environmental DNA Laboratory at Curtin University conducts research into measuring and monitoring biodiversity using eDNA. The ARC Training Centre for Healing Country, which is housed at Curtin University, conducts relevant research on restoration, socio-economics and eco-health, with active engagement of Indigenous communities.

Murdoch University: The Harry Butler Institute at Murdoch University and its Centre for Terrestrial Ecosystem Science and Sustainability conduct research into biodiversity conservation and restoration. In particular, the centre's research on wildlife biology and conservation, terrestrial ecosystem management and ecological restoration have some connection to this research program.

Edith Cowan University (ECU): The Conservation and Biodiversity Research Centre at ECU conducts research to conserve biodiversity with a focus on understanding principles and mechanisms of species loss and thereby developing management solutions.

Community groups

There are many community groups that are active in undertaking biodiversity-related research and conservation activities throughout the state. Some examples are Wilderness Society WA, Western Australian Naturalists' Club, Urban Bushland Council WA Inc, National Trust of WA, and Indigenous Ranger Groups. These groups work closely with local communities and engage them in, and inform them about, conservation works.

Environmental consulting companies

Environmental consultants are generally members of the Environmental Consultants Association (ECA), the leading professional body of commercial environmental consultants in Western Australia. The ECA represents the interests of members and promotes the development of the environmental industry. Environmental consulting companies conduct biodiversity-related research to provide services to businesses and other stakeholders. In particular, their work in flora and fauna surveys and their monitoring are relevant to this research program.

Cooperative Research Centres

Transformations in Mining Economies (CRCTiME) CRCTiME works to transform mine sites once they are closed for better economic, social, cultural and environmental outcomes. Its innovative research program on natural capital accounting for mine sites is highly relevant to this research program, as mining activities and biodiversity conservation are both important for Western Australia (Maybee et al. 2023a, Maybee et al. 2023b, O'Grady et al. 2023, Pantelic et al. 2023). In implementing the Biodiversity Economics and Finance Research Program, a coordinated approach should be developed to avoid duplication and enhance complementarity in research with CRCTiME.

ARC Training Centre for Healing Country: This ARC centre has a focus on Country and Indigenous people. It conducts research on restoration, socio-economics and eco-health to unlock opportunities for Country in partnership with universities, government departments, community organisations and businesses in Western Australia.

National Environmental Science Programs

The Resilient Landscapes Hub: The hub conducts research on a broad range of topics to support the resilience of natural landscapes and biodiversity in Australia, with a focus on finding new ways to restore and enhance resilience. It works closely with universities, governments (local to federal), and non-government and Indigenous organisations. Its research on threatened species, community and Indigenous values, landscape restoration, Indigenous knowledge and monitoring of biodiversity are of particular relevance to this research program.

Relevant interstate and global research and expertise

Melbourne Biodiversity Institute is associated with Melbourne University. It comprises multi-disciplinary research teams and works with diverse stakeholders and partners. It conducts research to find solutions and actions to address biodiversity challenges.

Biodiversity Council is an independent expert group founded by 11 Australian universities to promote evidence-based solutions to Australia's biodiversity crisis. It conducts research into different aspects of biodiversity conservation and acts as a trusted expert voice to share information on Australia's most pressing biodiversity issues to the community, businesses and governments to motivate effective evidence-based actions.

PricewaterhouseCoopers (PwC) is a multinational professional services provider in a range of areas, including biodiversity and nature. It provides knowledge products in the areas of biodiversity economics and finance to inform businesses, governments and other stakeholders (PwC 2022b).

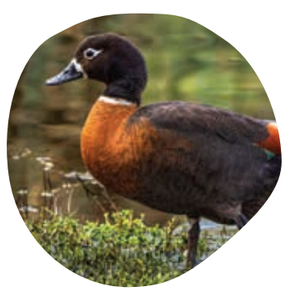
Deloitte Access Economics (Deloitte) is a multinational professional services provider that provides services in the areas of nature and biodiversity, and generates knowledge products in biodiversity economics and finance. In a work prepared for the Australian Academy of Sciences, it found that investing AU$1 to discover and document a species would generate benefits for Australia ranging from AU$4 to AU$35 (Deloitte 2021). Another of its knowledge products indicates that every €1 spend on the Global Biodiversity Information Facility could result in benefits ranging from €3 to €12 (Deloitte 2023).

Ernst and Young (EY) is a multinational professional services provider that also works in the areas of biodiversity and nature. It generates knowledge products in the areas of biodiversity economics and finance as a service to businesses, organisations and other stakeholders (EY 2021). It is also actively involved in Nature Positive Initiatives – Halt and Reverse Nature Loss by 2030 – launched by the coalition of 27 organisations in 2023. In a report to the Australian Conservation Foundation, it has found that approximately 22% (AU$260.79 billion) of all outstanding lending finance in Australia accounts for the four sectors – agriculture, property, resources and energy (EY 2023) – that have strong dependency and impact on biodiversity and nature.

KPMG provides professional consulting and financial services in the areas of biodiversity and nature like other big accounting firms. It launched the Nature Positive Challenge, which awards ventures with nature-positive activities. It also generates knowledge products to provide guidance to different stakeholders on integrating biodiversity and nature into business strategies (KPMG 2023).

The following list contains some of the prominent global-level organisations and platforms that work closely in the areas of biodiversity economics and finance.

- Biodiversity and Economics for Conservation (BIOECON): https://www.bioecon-network.org
- The Economics of Ecosystem and Biodiversity (TEEB): https://www.unep.org/topics/teeb
- Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES): https://www.ipbes.net/
- System of Environmental Economic Accounting – Ecosystem Accounting (SEEA EA): https://seea.un.org/ecosystem-accounting
- OECD Biodiversity: https://www.oecd.org/en/topics/biodiversity.html
- WEF Centre for Nature and Climate: https://centres.weforum.org/centre-nature-and-climate/home
- World Bank Global Program on Sustainability: https://www.worldbank.org/en/programs/global-program-on-sustainability
- Biodiversity and Ecosystem Services Network (BESNet): https://www.besnet.world/
- IUCN Business, Finance and Economics: https://iucn.org/our-work/business-finance-and-economics
- UNEP Finance Initiative: https://www.unepfi.org/nature/nature/
- UNDP Biodiversity Finance: https://www.undp.org/nature/our-work-areas/biodiversity-finance
- Biodiversity Finance Initiative (BIOFIN): https://www.biofin.org/
- UNEP WCMC Nature Economy: https://www.unep-wcmc.org/en/nature-economy
- Taskforce on Nature-related Financial Disclosures (TNFD): https://tnfd.global/about/
- The Nature Conservancy (TNC): https://www.nature.org/en-us/
- Conservation International: https://www.conservation.org/home
- World Wildlife Fund for Nature (WWF): https://wwf.panda.org/



Conclusion

Considering the implementation of Australia's Strategy for Nature (2024–2030) and the complexity of mainstreaming biodiversity into decision-making, WABSI initiated a research prioritisation process aimed at identifying critical knowledge gaps in biodiversity economics and finance for Western Australia. Our work coincides with the emerging reality that 'nature in the balance sheet' is no longer just a concept; biodiversity and nature loss are material financial risks to businesses.

Better environmental management is urgently needed and there is a growing need to understand how economic activity impacts nature and biodiversity, and what the dependencies, risks and opportunities are.

The framework to prioritise biodiversity economics and finance research for Western Australia was developed through an iterative process of consultations and workshops with diverse stakeholders, including end-users and researchers. The framework presents knowledge gaps and research priorities in two parts: overall program-level priorities and sectoral priorities for the primary production, resources, services and financial sectors. The priorities are presented under two themes – Understanding and Mainstreaming – and nine focus areas: Learn, Measure, Value, Account For, Enabler, Economics, Market, Finance and Practice.

Overall priorities are the common priorities at the state level across the four sectors, while sectoral priorities are specific to those sectors. Addressing the knowledge gaps identified in this prioritisation is central to enabling the mainstreaming of biodiversity into economic and financial decision-making of the private and public sectors in Western Australia.

The top-ranked priority focus areas for targeted research are those related to measuring biodiversity, valuing biodiversity and the economics (benefits and costs) of biodiversity. Some of these priorities overlap at the sectoral level: basic learning of biodiversity (for the primary production sector), biodiversity accounting (for the resources and services sectors) and biodiversity financing (for the financial sector) are the top focus areas for sectoral research priorities.

For overall program and sectoral levels, focus areas and key knowledge gaps were identified individually and prioritised in developing the research program. An effective governance structure and securing adequate funding are key to the success of the research program.

By fostering collaboration, aligning with existing initiatives and ensuring that research outcomes benefit end-users, this program provides a pathway to maximise the use of new knowledge and transform the report's findings into tangible environmental, social and economic benefits across Western Australia.

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Appendix 1.

List of experts consulted

1. Laura Waterford, Pollination Group
2. Margaret Byrnes, Department of Biodiversity, Conservation and Attractions
3. Larissa Taylor, Savoir Consulting
4. Luke Bayley, South Coast NRM
5. Joe Heffernan, South Coast NRM
6. Tom Picton-Warlow, Department of Primary Industries and Regional Development
7. Jon Chadwick, PwC
8. Lucas Carmody, PwC
9. Erika Korosi, The Conservation International
10. Chilla Bulbeck, Emeritus Professor
11. Michael Court, Western Australian Treasury
12. Richard Watson, Western Australian Treasury
13. Melaine Davies, Western Australian Local Government Association
14. Nicole Matthews, Western Australian Local Government Association
15. Niki Curtis, Western Australian Local Government Association
16. Christopher Hossen, Western Australian Local Government Association
17. Anneke Monte, Umwelt
18. Rob Karelse, Umwelt
19. Mitt Ramgobin, Umwelt
20. Angus Morrison-Saunders, Edith Cowan University
21. Hamish Worsley, NMG Consulting
22. Ann Ward, Freelancer
23. Tim Cooper, BHP
24. Phil Cryle, BHP
25. Alice Taysom, BHP
26. Bruce Webber, CSIRO
27. Emily Briggs, Department of Water and Environmental Regulation
28. Jess Boyce, Western Australian Forest Alliance
29. Crispin Underwood, Crest Environmental Consulting
30. Bronwyn Claire, Ortec Finance
31. Kristen Williams, CSIRO
32. Lizzy Lowe, Edith Cowan University
33. Emily Lewis, Department of Water and Environmental Regulation
34. Stuart Clarke, Department of Water and Environmental Regulation
35. Greg S Smith, CSIRO
36. Shivin Kohli, WEF
37. Anthony O'Grady, CSIRO
38. Sarah Luxton, CSIRO
39. Sam Nicol, CSIRO
40. Anthea Coggan, CSIRO
41. Libby Pinkard, CSIRO
42. Gabriela Scheufele, CSIRO
43. Franziska Schrodt, University of Nottingham
44. Maria Nijnik, James Hutton Institute
45. Simone Martino, James Hutton Institute
46. David Miller, James Hutton Institute
47. Diana Valero, James Hutton Institute
48. Sam Poskitt, James Hutton Institute
49. Chen Wang, James Hutton Institute
50. Vern Newton, Hanson
51. Cameron Whiteside, Westpac
52. James Shaddick, Department of Primary Industries and Regional Development
53. Keith Claymore, Department of Primary Industries and Regional Development
54. Sally Forbes, Department of Primary Industries and Regional Development
55. Amir Abadi Ghadim, Department of Primary Industries and Regional Development
56. Josh Dorrough, NSW Environment
57. David Broadhurst, Perth NRM
58. Bonnie Jupp, Perth NRM
59. Keith Pekin, Perth NRM
60. Elizabeth (Liz) O'Leary, Macquarie Asset Management
61. Sue Ogilvy, Farming for the Future
62. Jim Radford, Farming for the Future/ La Trobe University
63. Angela Hawdon, Farming for the Future
64. Bonnie Mappin, KPMG
65. Kieran Birch, Rio Tinto
66. Sean Savage, Rio Tinto
67. Sean Pascoe, CSIRO
68. Helen Murphy, CSIRO
69. Michael Vardon, ANU
70. Jane Chambers, Murdoch University
71. Cornelia Krug, University of Zurich/WBF
72. Lucy E Commander, Alcoa
73. Stephen A White, Alcoa
74. Lisa Adams, ECA
75. Richard McKenzie, Western Australian Treasury Corporation

Appendix 2a.

List of participants – Workshop 1 (Issues identification)

Primary production sector (18 November 2024)

1. Luke Bayley, South Coast NRM
2. Joe Heffernan, South Coast NRM
3. Blair Parsons, Greening Australia
4. Franco Renteria, Facey Grower Group
5. James Shaddick, Department of Primary Industries and Regional Development
6. Keith Claymore, Department of Primary Industries and Regional Development
7. Tom Picton-Warlow, Department of Primary Industries and Regional Development
8. Katherine Allen, Northern Agricultural Catchments Council
9. Sally Wilkinson, South West NRM
10. Owen Nevin, WABSI
11. Chante Fourie, WABSI
12. Ram Pandit, WABSI

Resources sector (19 November 2024)

13. Alice Taysom, BHP
14. Stephen White, Alcoa
15. Rebecca Evans, Rio Tinto
16. Lucas Cary, Rio Tinto
17. Vern Newton, Hanson Construction Materials
18. Alex Dunn, Hanson Construction Materials
19. Brock Smith, Hanson Construction Materials
20. Rory Swiderski, South32
21. David Gregory, South32
22. Helen Ensikat, Department of Biodiversity, Conservation and Attractions
23. Ursula Kretzer, Department of Water and Environmental Regulation
24. Heidi Mippy, Curtin University
25. Jared Nelson, FMG
26. Bryan Maybee, Curtin University and CRC TiME
27. Chante Fourie, WABSI
28. Ram Pandit, WABSI

Services sector (21 November 2024)

29. Mitt Ramgobin, Umwelt: Environmental and Social Consultants
30. Angus Morrison-Saunders, Edith Cowan University
31. Nicole Matthews, Western Australian Local Government Association
32. Emily Lewis, Department of Water and Environmental Regulation
33. Catherine Turnbull, Chamber of Minerals and Energy Western Australia
34. Johnny Machon, Department of Primary Industries and Regional Development
35. Rhiannon Hardwick, Conservation Council of Western Australia
36. Mia Pepper, Conservation Council of Western Australia
37. Crispin Underwood, Crest Environmental Consulting
38. Abbie Rogers, The University of Western Australia
39. Heidi Mippy, Biologic
40. Belinda O'Connell, Biologic
41. Alice Greenwood, Biologic
42. Dinesh Thapa Magar, ex-WABSI staff
43. Chante Fourie, WABSI
44. Ram Pandit, WABSI

Financial sector (22 November 2024)

45. Larissa Taylor, Savoir Consulting
46. Bronwyn Claire, Ortec Finance
47. Richard McKenzie, Western Australian Treasury Corporation
48. Tim Coombs, KPMG
49. Martin Van Bueren, Synergy
50. Raveen Ekanayake, Western Australian Treasury
51. Andrew Robins, Western Australian Treasury
52. Robyn Chesney, Biologic
53. Emma Scaife, The University of Western Australia
54. Jonathan Bloch, ANZ Bank
55. Bonnie Mappin, Minderoo Foundation
56. Dinesh Thapa Magar, ex-WABSI staff
57. Chante Fourie, WABSI
58. Ram Pandit, WABSI

Appendix 2b.

List of participants – Workshop 2 (Research prioritisation)

In-person workshop (12 June 2025)

1. Katherine Allen, Northern Agricultural Catchments Council
2. Black Andrew, CBH Group
3. Jonathan Block, ANZ Bank
4. Lucas Cary, Rio Tinto
5. Bronwyn Claire, Ortec Finance
6. Alex Humphry, Western Australian Treasury Corporation
7. Johny Machon, Department of Primary Industries and Regional Development
8. Bryan Maybee, Curtin University and CRC Time
9. Heidi Mippy, Curtin University
10. Angus Morrison-Saunders, Edith Cowan University
11. Katherine Neaves, Conservation Council of Western Australia
12. Renata Paliskis, Wheatbelt NRM
13. Blair Parsons, Greening Australia
14. James Shaddick, Department of Primary Industries and Regional Development
15. Larissa Taylor, Savoir Consulting
16. Dinesh Thapa, ex-employee WABSI/independent
17. Martin Van Bueren, Synergy
18. Joanne Wisdom, Grower Group Alliance
19. Eilin Magnan, WABSI
20. Owen Nevin, WABSI
21. Ram Pandit, WABSI

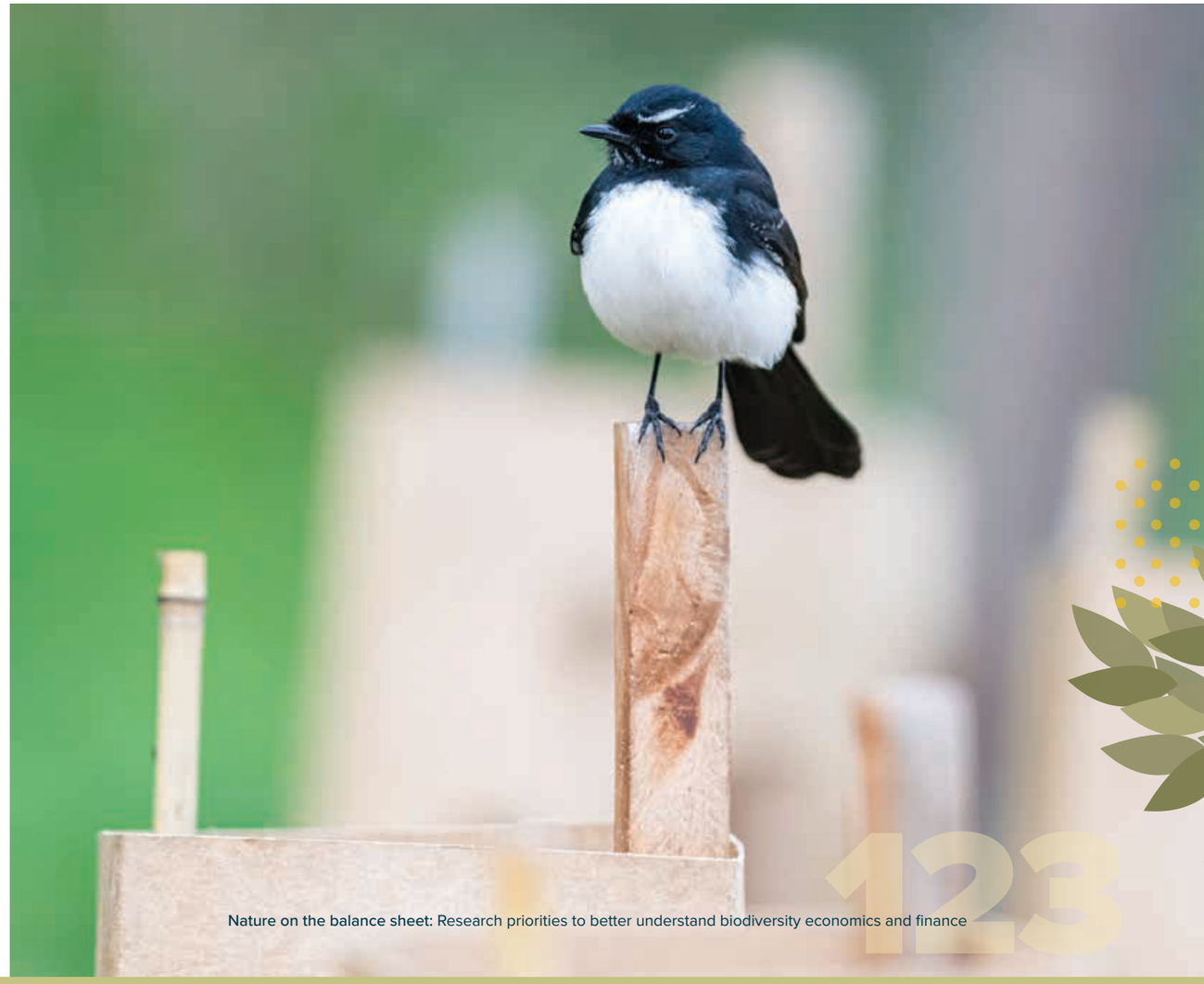
Online workshop (13 June 2025)

22. Lucy Commander, Alcoa
23. Todd Edwards, FMG
24. Emily Lewis, Department of Water and Environmental Regulation
25. Anneke Monte, Umwelt: Environmental and Social Consultants
26. Adrian Pinder, Department of Biodiversity, Conservation and Attractions
27. Abbie Rogers, The University of Western Australia
28. Rory Swiderski, South32
29. Carla Swift, South West NRM
30. Anita Logiudice, Chamber of Minerals & Energy WA
31. Sally Wilkinson, South West NRM
32. Ram Pandit, WABSI

Appendix 2c.

Further consultations with First Nations scholars

1. Oral McGuire
2. Heidi Mippy
3. Anne Poelina



Appendix 3.

Issues identification from sectoral workshops

A-3 BOX 1. Issue identification: Primary production sector

- Need to effectively apply and up-scale restoration and biodiversity conservation efforts with a focus on long-term climate adaptation.
- Need to develop robust and effective strategies to balance biodiversity conservation with land-use priorities (e.g. learn from global case studies as well, such as from Brazil).
- Need for innovative restoration techniques, especially considering the changing climate and the need for species adaptation.
- Need to efficiently expand key opportunities, such as land restoration efforts, enhanced seed banks and better managed lands, for long-term biodiversity improvements.
- There is a risk of moving too fast without sufficient regulation or policy certainty, which could undermine biodiversity efforts and discourage investments.
- How to bridge the gaps between technical and community understanding of biodiversity, which is essential for broader adoption of practices/interventions?
- What is the role of technology (e.g. remote sensing or new technologies) in improving biodiversity monitoring?
- Need to improve the effectiveness of restoration projects, particularly in areas with limited ecological knowledge.
- How can biodiversity conservation strategies be adapted to address the challenges of climate change, particularly with shifting species?
- How can biodiversity projects be designed to accommodate/consider both current and future climatic conditions?
- Need to conduct a market analysis to understand supply and demand dynamics of biodiversity credits.
- Need ways to integrate supply and demand dynamics into existing market mechanisms or frameworks.
- Need to conduct research to understand demand for biodiversity credits.
- Find a balance between bottom-up and top-down ways of thinking about biodiversity measurement, financing and mainstreaming.
- Need for a prospective analysis to estimate costs to Western Australia's economy for inaction or not investing in nature or mainstreaming nature and biodiversity into decision-making.
- Need clear financial incentives for landholders to engage in biodiversity projects, particularly in areas where benefits accrue in the long-term or are abstract in nature.
- How can farmers or landholders align natural capital projects with government priorities and processes to minimise regulatory risk? Need policy framework or guidance.

A-3 BOX 2. Issue identification: Resources sector

- Find a balance between bottom-up and top-down ways of thinking about biodiversity measurement, financing and mainstreaming.
- Need for a prospective analysis to estimate costs to Western Australia's economy for inaction or not investing in nature or mainstreaming nature and biodiversity into decision-making.
- Need clear financial incentives for landholders to engage in biodiversity projects, particularly in areas where benefits accrue in the long-term or are abstract in nature.
- How can farmers or landholders align natural capital projects with government priorities and processes to minimise regulatory risk? Need policy framework or guidance.
- Identifying priority metrics for biodiversity is complex as not everything can be measured, thus the focus needs to be on key and impactful elements.
- The methodology for measuring biodiversity is uncertain, especially as it varies across regions and sectors (e.g. terrestrial vs aquatic) – need a defined but flexible approach.
- There is a need for consistent and standardised methods for measuring biodiversity for accounting and regulatory purposes (need for frameworks, tools and guidance).
- While significant data exists on biodiversity and ecosystems, there is a gap in translating this data into actionable insights and metrics, especially for aquatic ecosystems.
- There is a risk of implementing biodiversity strategies without clear methodologies or metrics to measure success, leading to ineffective or costly outcomes.
- Need to develop a standardised approach to measure biodiversity that works across sectors and regions, which is a key challenge.
- Data uncertainty and gaps in research (especially for aquatic ecosystems) make it difficult to quantify biodiversity impacts accurately.
- Need to identify most critical gaps in biodiversity data, and ways to address them through research and innovation.
- Develop standardised metrics to measure biodiversity across different ecosystems.
- Difficult to value biodiversity in financial terms, especially in conveying these values to investors or decision-makers who may not fully understand or prioritise it.
- Need holistic approach to valuation that would capture economic, cultural and religious values of biodiversity to society.
- The complexity of valuing biodiversity in dollar terms creates challenges in justifying investment to stakeholders and decision-makers.

(Continued...)

Appendix 3.

A-3 BOX 2. Issue identification: Resources sector (continued)

- The complexity of assessing ecosystem services, including intangible values like cultural or spiritual significance, complicates the assessment (or measurement) process.
- Need most effective approaches to value biodiversity in monetary terms for decision-making.
- Natural capital accounting offers significant potential for incorporating biodiversity into financial planning, with potential to attract private sector investment in biodiversity initiatives.
- Need to embrace the opportunity to embed natural capital accounting into systems like environmental impact assessments to demonstrate practical, measurable biodiversity outcomes.
- Need to foster landscape-scale approaches to restoration, including partnerships between governments, landowners and local communities, in order to drive biodiversity outcomes across regions.
- What are the best practices for designing and implementing biodiversity offsets that are both effective and equitable?
- How can we consolidate existing biodiversity research to create a robust evidence base for decision-making?
- Existing policies often fail to account for biodiversity appropriately, and rapid policy changes can complicate long-term planning and investment [need for policy inclusion and certainty].
- The speed of policy change often outpaces industry's ability to implement, creating risks of regulatory misalignment.
- Political and policy cycles (short-term focus) hinder long-term, sustainable action on biodiversity.
- Need a long-term strategic approach or plan for biodiversity and nature
- Policy uncertainty around biodiversity offsets and how to integrate them into land-use planning remains a major barrier.
- Need for collaboration across sectors (mining, agriculture etc.) to achieve biodiversity outcomes, but aligning different interests remains challenging.
- The potential for Western Australia to position itself as a global leader in biodiversity restoration and natural capital management exists, especially given its natural resources and expertise in land management.
- Need for a better collaboration between industries, government and research institutions to share knowledge and scale restoration efforts.
- Need for a better leveraged policy to drive industry action, with clear, simplified rules and incentives for biodiversity conservation (e.g. through offset mechanisms or restoration funding).

A-3 BOX 2. Issue identification: Resources sector (continued)

- Need for a strategic land use plan and policy interventions, which can help enhance biodiversity, including the establishment of biodiversity corridors or securing land for conservation.
- Need to integrate social science into biodiversity initiatives that can help change attitudes and drive public engagement through community-driven efforts.
- Need for a long-term perspective – the political cycles and short-term focus may delay or complicate the adoption of long-term biodiversity strategies.
- What policy reforms are needed to align biodiversity goals with economic development, particularly in industries like mining and agriculture?
- Government needs to create policies that incentivise private sector investment in biodiversity conservation.
- Investors are increasingly demanding biodiversity considerations, but there is a lack of trusted methodologies to quantify the financial value of biodiversity actions.
- There are barriers to success in translating biodiversity values into financially viable models for industry, especially when the regulatory framework is still developing or less clear.
- The lack of financial incentives for businesses to invest in biodiversity poses a risk of stagnation in the sector.
- The perceived high-risk profile of biodiversity projects could deter investors unless clear financial returns can be demonstrated.
- Scaling up biodiversity restoration requires significant investment in training, capacity building and research to ensure that methods are effective and sustainable.
- Need to identify roles of local communities and farmers in driving biodiversity restoration, and how they can be incentivised.
- Need to identify financial mechanisms that can be developed to encourage private investment in biodiversity conservation.
- There is a need to assess collective impacts of (resource projects) on biodiversity and associated values (benefits and costs) to society (say, health benefits as well).
- Need proof-of-concept that investing in biodiversity and nature is a sound economic case.
- Farmers, businesses and industry players need to see clear benefits to adopting biodiversity-friendly practices.
- Communicate the economic benefits of biodiversity, such as ecosystem services, to decision-makers in the context of their decision environment.
- How can market-based approaches, such as biodiversity credits, help drive demand for biodiversity-positive products?

(Continued...)

Appendix 3.

A-3 BOX 2. Issue identification: Resources sector (continued)

- What role can technological innovations (e.g. blockchain, digital platforms) play in improving transparency in biodiversity markets?
- How can biodiversity markets be made financially viable and scientifically credible?
- There is a tension between the practicality of implementing biodiversity conservation initiatives and achieving significant environmental outcomes.
- High-risk projects may be needed for large-scale changes, but mainstreaming (biodiversity) adoption requires reducing the project risk profile to attract investors.
- Need for future-proofing policies (policy certainty) to accommodate climate change and restoration goals, which will be essential to maintaining biodiversity in the long term.
- Need for mainstreaming biodiversity into broader environmental and economic goals to build a more resilient and sustainable system.
- Increasing interest in biodiversity from investors provides an opportunity to make biodiversity a mainstream consideration in decision-making.
- Policy changes that lack coordination across levels of government (e.g. federal vs state) could create confusion or unintended consequences for businesses and landholders.
- Misalignment in biodiversity considerations between sectors (e.g. mining and agriculture) could result in competing priorities and slowing progress.
- Biodiversity restoration may not be adequately scaled up due to funding, knowledge gaps or regulatory barriers.
- Aligning biodiversity goals with other social and economic priorities (e.g. housing, tourism and public health) will be a critical challenge.
- The challenge lies in integrating land-use practices with a focus on social and economic priorities (e.g. agriculture, housing) and biodiversity conservation in the face of competing demands on land.
- Need effective engagement mechanism/approach among stakeholders across sectors to collaborate on biodiversity conservation goals.
- What systemic changes are needed within industries to integrate biodiversity into long-term land use and development planning?
- Need for a shift from current paradigm of compliance driven to proactive biodiversity stewardship within and across sectors.

A-3 BOX 3. Issue identification: Services sector

- How to achieve nature-positive outcomes where human activities interact with biodiversity recovery in different contexts?
- Need to know different methods to improve biodiversity assessment using pilot projects based on eDNA or other new technologies.
- Demonstrate successful case studies that can help attract both public and private sector investments in nature/biodiversity conservation.
- Need to use case studies and pilot projects to show economic and ecological benefits of biodiversity conservation to gain political support.
- How to connect public with nature to increase conservation actions?
- There are issues with the quality, accessibility and consistency of biodiversity data.
- Lack of state-level vegetation mapping.
- Poor consolidation of data across sectors.
- Inefficiency in data generation and sharing.
- Data generated by government and private entities are not interoperable or standardised, complicating measurement and reporting of biodiversity.
- Lack of baseline data on biodiversity, making it difficult to assess the effectiveness of conservation efforts.
- The quality of the available data, particularly around biodiversity metrics, is inconsistent and varies across Western Australian regions.
- Lack of standard metrics to measure biodiversity.
- Lack of consensus on metrics to measure biodiversity.
- Need for standardisation of biodiversity metrics, especially at the state level, which would facilitate better measurement, reporting and decision-making.
- Creating shared databases of biodiversity data, similar to Queensland's ecosystem mapping, can make data more accessible and reliable.
- How can we improve the consistency and quality of biodiversity data, particularly in relation to emerging technologies like eDNA?
- What are the challenges in reconciling observational data with inferred decision-making processes?
- What is the true baseline for biodiversity, especially considering climate change and human activities?
- Available biodiversity data is insufficient/inadequate, making it difficult to value biodiversity accurately.

(Continued...)

Appendix 3.

A-3 BOX 3. Issue identification: Services sector (continued)

- The intrinsic value of nature and biodiversity is not well understood or integrated into decision-making.
- Lack of a standard metric to measure biodiversity complicates valuation of biodiversity.
- Challenges in integrating biodiversity valuation with financial systems – particularly when considering the cost of inaction (e.g. loss of ecosystem services).
- Need for a consistent approach/framework to value biodiversity.
- There is a tension between intrinsic and instrumental values and valuation of biodiversity.
- It's challenging to quantify intrinsic value (importance of biodiversity on its own) and relational values of biodiversity and nature, such as cultural or spiritual importance, which are often disregarded in economic models.
- Often a disconnect between public perception of biodiversity value and the actual on-the-ground actions required.
- Challenge in measuring social/cultural values (e.g. public opinion, cultural importance) and making them actionable in financial and policy frameworks.
- Increasing awareness of the intrinsic and social value of nature is critical for shifting public perception.
- Using media and community engagement strategies, like place-based approaches to biodiversity valuation, can help raise the profile of biodiversity issues.
- How can we better quantify the value of urban nature and the impacts of biodiversity loss in cities (e.g. the economic and social value of tree canopy)?
- There are multiple frameworks to measure and account for biodiversity and nature, but these are not well aligned, making it difficult to make accurate comparisons or assess progress over time [need inter-operability across the frameworks, if different frameworks are used].
- Capturing Indigenous and local knowledge in the natural capital accounting process is essential but often overlooked.
- Lack of inclusion of cultural and social perspectives in biodiversity measurement, valuation and accounting, which is crucial for an effective and holistic understanding of biodiversity and ecosystem services.
- There's a need for a consistent approach/framework to accounting and reporting biodiversity.
- Various organisations are using different frameworks for natural capital accounting, indicating interoperability and a lack of common framework for natural capital accounting.
- Need transparent and standardised reporting mechanisms for biodiversity impacts and financial returns of businesses that will help attract more investment.

A-3 BOX 3. Issue identification: Services sector

- A regional approach to natural capital accounting could provide a foundation for standardised, government-supported data across sectors, making it more cost-effective. Implementing regional natural capital accounting frameworks and aligning them with national and global targets (e.g. TNFD) could streamline data collection, reporting and financing.
- Cost of biodiversity loss is often not factored into business or government decision-making.
- How can we effectively quantify and integrate public perception of biodiversity values into the decision-making process?
- Policies are fragmented, with a focus on sectors like mining, leaving biodiversity largely unaddressed in a cohesive manner.
- Need ways to integrate Indigenous knowledge into official biodiversity frameworks (measurement, valuation, accounting), but finding ways to do so requires collaboration and respect for local knowledge systems.
- Need to develop methodologies that link environmental improvements directly to social and economic outcomes.
- Governments must develop and promote policies that encourage co-investment and allow for flexible mechanisms, such as hybrid offsetting models or green bonds, to support nature-positive initiatives.
- Political challenges (in Western Australia), with the dominant focus on industries like mining, and societal resistance to changing long-standing practices, may slow the adoption of biodiversity conservation policies.
- Government-backed concessional loans and risk-sharing models can lower barriers to private sector participation in conservation.
- Social nudges and educational campaigns for biodiversity and nature can drive behavioural change and increase public support for policy shifts.
- Government and private sector collaboration will be crucial in making the natural capital accounting frameworks actionable.
- Securing commitments from government regulators and large corporations for biodiversity and natural capital accounting is vital.
- Need for policymakers to negotiate with businesses and investors to address the biodiversity finance gap.
- Lack of financial and policy incentives to drive private and public investment in biodiversity conservation.
- Existing approach of biodiversity financing is highly fragmented; there is a need for an integrated approach to finance biodiversity conservation.

(Continued...)

Appendix 3.

A-3 BOX 3. Issue identification: Services sector (continued)

- Need for more robust financial instruments and tools, such as biodiversity credits, to bring in capital for long-term biodiversity conservation.
- The financial community struggles to price biodiversity risks and integrate nature-related financial disclosures into business models.
- Financial uncertainty limits investment in biodiversity conservation projects, delaying the adoption of nature-positive approaches.
- Green bonds, biodiversity credits and ecosystem service payments present significant opportunities for financing biodiversity initiatives.
- By bundling carbon and biodiversity credits together, these instruments and tools (green bonds, biodiversity credits, payment for ecosystem services) can drive investment in conservation and sustainable land management practices.
- The involvement of both public and private sectors in funding and data generation will be crucial for building sustainable biodiversity financing mechanisms.
- Need to learn from insurance companies that can provide valuable insight into how biodiversity risks (e.g. species extinction, habitat loss) can be priced into financial products.
- Developing new financial instruments, such as green bonds or biodiversity-based insurance products, can provide the necessary funding for biodiversity initiatives.
- What are the potential alternatives to traditional biodiversity offsetting, such as hybrid models or region-specific approaches?
- Build flexibility into biodiversity financing mechanisms to suit local contexts.
- Quantify the cost of not protecting biodiversity in terms of lost ecosystem services (e.g. coastal protection, flood regulation).
- Demonstrate the economic, ecological and social benefits of nature-positive actions.
- Develop a financial value proposition for biodiversity, including the cost of inaction, to integrate it into economic planning and decisions.
- Quantify the cost of inaction, particularly in terms of ecosystem services (e.g. loss of tree canopy, pollination).
- The risk of continued biodiversity loss could lead to significant economic consequences, particularly in sectors like agriculture, where pollination and soil health are vital.
- Disconnect between national and state policies, with a lack of commitment to integrating biodiversity into broader economic and financial systems.
- Need to align local, national and international biodiversity targets to achieve expected outcomes.
- Need for clear actions from both the public and private sectors for biodiversity to be considered a mainstream issue.

A-3 BOX 4. Issue identification: Financial sector

- There is no consensus on what these terms (no net loss, net gain) mean for financial markets, creating confusion in policy and implementation.
- Failure to understand and act on ecosystem tipping points could lead to irreversible biodiversity loss, with cascading effects on Western Australia's natural capital and economy.
- Understand the effectiveness of education-focused awareness raising activities on role of biodiversity to human wellbeing and the impact of such activities on biodiversity outcomes.
- Implement large scale longitudinal surveys on public attitude to biodiversity to inform relevant public policy.
- Need to know sub-sovereign treasury functions in Australia [UK, Canada] in the context of how they approach biodiversity, starting with New South Wales Treasury, to capitalise on lessons learned.
- There is an issue of fragmented environmental and biodiversity data.
- There is a challenge or significant hurdle of accurately measuring biodiversity, defining clear baselines and tracking changes over time.
- Understanding ecosystem tipping points is crucial but underdeveloped in current decision-making frameworks.
- Existing data on biodiversity and ecosystem services is underused due to lack of integration, privacy concerns and regulatory restrictions.
- There is a lack of a centralised, independent authority to establish and track baseline biodiversity metrics in Western Australia.
- The absence of clear privacy legislation around environmental data, and concerns about data misuse, hinder effective data sharing, particularly in industries like mining.
- There's an opportunity to aggregate existing environmental data and apply machine learning to create actionable insights and track biodiversity changes more effectively.
- Creating a clear and independent baseline for biodiversity, using data from agencies like the Australian Bureau of Statistics or the United Nations' System of Environmental-Economic Accounting, will help with tracking progress and guiding decision-making.
- Efforts like the Australian Bureau of Statistics' natural capital accounting and the the United Nations' System of Environmental-Economic Accounting could play a role but need more attention and integration with Western Australian contexts.
- Developing a robust risk management framework that includes biodiversity risks could provide clear guidance for businesses and government agencies, helping them make informed decisions.
- Adopt frameworks that align well with the global environmental, social and governance standards.

(Continued...)

Appendix 3.

A-3 BOX 4. Issue identification: Financial sector (continued)

- Show how nature-based solutions can reduce risk and provide long-term benefits.
- There's a limited understanding of the true value of biodiversity.
- Valuing ecosystem tipping points are crucial but underdeveloped in current decision-making frameworks.
- Lack of approaches to price nature risks to businesses.
- Find cost-effective ways to integrate nature risks into economic modelling.
- There is insufficient government funding and capacity to support biodiversity measurement and valuation, policy implementation and long-term planning.
- Government policies do not align well with the private sector's needs, especially in terms of incentivising biodiversity conservation or sharing risks.
- There's no unified approach to understanding and managing biodiversity risks within corporations or government agencies.
- Regulatory, reputational and financial risks are arising for companies not managing biodiversity risks.
- Without clear definitions and policies, such as on 'no net loss', there is a risk of ineffective environmental actions or inaction, which could affect Western Australia's international reputation.
- Educating the public and industry about the value of biodiversity and ecosystem services could shift the market and policy context towards more sustainable practices.
- Framing biodiversity protection as a strategic advantage to businesses could incentivise them to participate in conservation actions.
- Framing biodiversity conservation as a form of insurance against climate and environmental risks could appeal to both the public and businesses, positioning conservation as a cost-effective, proactive strategy for the future.
- Biodiversity finance is an issue because funding is insufficient for long-term biodiversity protection.
- There's no clear definition of the government's risk appetite regarding biodiversity loss.
- Focus of financial institutions on environmental outcomes is increasing but inadequate (e.g. stakeholders like investors, banks and insurers are increasingly focused on environmental outcomes).
- Developing new financing models (e.g. green bonds, biodiversity credits) to fund biodiversity projects could create a sustainable funding stream for conservation efforts.
- Using environmental data for social licence and reputational benefits can drive investment and public support for biodiversity projects.

A-3 BOX 4. Issue identification: Financial sector (continued)

- Lack of integration of biodiversity values into economic and policy decision-making.
- The link between biodiversity, its value and economic outcomes are not presented in a connected way that shows how protecting nature and biodiversity is contributing to economic outcomes.
- Public and government understanding of biodiversity as a public good – something valuable for society – is potentially lacking, affecting policy and framework development and financial investment.
- Failing to address biodiversity decline may lead to economic losses, especially in sectors like agriculture, tourism and resource extraction, which rely on healthy ecosystems.
- Failure to conserve biodiversity in Western Australia would risk or increase long-term social and economic costs arising from different sources, including reduced ecosystem services (e.g. pollination, water filtration), and exacerbate climate change impacts.
- Assess the component of biodiversity risk appetite of the government (with a focus on different aspects of biodiversity) and retro-fit the existing contexts to find areas for improvement.
- There are challenges in ensuring biodiversity offsets are genuine and effective, with concerns over future tenure security and fraud.
- Current government policies around environment and incentivising actions (e.g. conservation acts) are outdated and lack effective execution.
- Need for (financial) policy modification to focus on long-term environmental goals.
- Need for coherence in policy decisions between immediate economic goals (e.g. growth, inflation) and long-term sustainability and conservation goals.
- There is insufficient policy to manage and aggregate (financial) data effectively for environmental decision-making.
- Need to define or establish risk appetite for biodiversity in the financial system.
- Lack of clearly defined biodiversity risk appetite results in a lack of policy or frameworks to manage this risk effectively.
- Short-term policy goals often undermine critical environmental actions.
- Need to build stronger collaborations between government, business and investors to align their actions around biodiversity protection and financial risk management.
- There is an opportunity to revise existing policies and create new ones (in Western Australia) that prioritise long-term biodiversity conservation, integrate nature into economic planning and address climate change.

Appendix 4.

Identification of overarching knowledge gaps through consultations and workshops, screened by research focus area and WABSI's research screening framework

Research focus area	Main knowledge gaps or research needs	Relevant WABSI research program*	WABSI's research screening framework				
			Research	Management	Policy	Communication	Funding
Learn							
1	Understand the link between biodiversity and business performance (financial outcomes) • Understand the link between site-specific biodiversity (nature) risks to corporate-level business risks • Know the risk profile of corporations or businesses (private sector) that encourages them to invest in biodiversity/public goods – risks such as regulatory; environmental, social and governance; reputational; and financial • Know robust and practical approaches to assess the impacts of biodiversity-related investment • Limited understanding of businesses on the attribution of biodiversity outcomes (hard to know what actions contribute to which results).	RE	✔	✔			
2	Develop practical methods to integrate biodiversity into land management decisions • Understand how farm activities interact with surrounding environment and vice versa in terms of economic output • Understand the link between natural capital investments and improved health and productivity in farms at a regional scale (e.g. reduced health costs, green jobs) • Quantify the relationship between stock of nature and biodiversity to farm productivity • Understand farmers' need for scalable and robust evidence.	IM	✔	✔			
3	Clarify the meaning and practical implications of key biodiversity concepts • Clarify what nature positive means • Find consensus on what these terms (no net loss, net gain) mean for financial markets • Clarify what the trading units in biodiversity markets are • Understand the concept of counterfactual in biodiversity assessments.	–	✔			✔	
4	Understand ecological interactions and resultant biodiversity outcomes of any interventions or actions • Know the connected link between activity, ecological interactions, and economic and ecological outputs • Understand the cause-effect relationship (response function) of any actions and resultant biodiversity outcomes in the farming context (through piloting) • Know cumulative (landscape-level) impact of actions at Site A on outcomes at Site B and vice versa • Know the extent and nature of cumulative impact of individual decisions on biodiversity at landscape level (for example, in the case of mining in the Pilbara).	RE, IM	✔	✔			
5	Understand stakeholders' motivations and information needs for biodiversity • Understand the stakeholder-specific (government, regulators, industry, financial institutions, communities) motivation to invest in or care about nature and biodiversity (social licence, regulation, philanthropy) • Know the value propositions of landholders to engage in natural capital accounting or biodiversity markets • Assess biodiversity-related information needs of each knowledge end-user • Know how the end-users want to use that information.	IM	✔				✔
Measure							
1	Establish a biodiversity data bank and provide access to existing data • Establish reference level and/or baseline data to monitor changes in biodiversity • Develop a system of data repository from existing but fragmented data • Provide access to existing biodiversity data and make it interoperable • Improve the quality of biodiversity data.	IM	✔	✔			
2	Identify the biodiversity data and measurement needs • Identify optimal level of complexity for biodiversity representation that can be used by markets • Identify how to measure variability and ecosystem interactions • Understand biodiversity data requirements for decision-making (what data, in what form, and for what purpose) • Identify the extent of granularity needed in biodiversity data (biological – gene, species, ecosystem; spatial – farm/business, landscape, region; temporal – seasonal and over time).	IM, RE, UB	✔				

* Relevant WABSI programs: RE= Restoration Economy, IM=Data and Information Management, UB=Building Biodiversity for Thriving Urban Ecosystems

(Continued...)

Appendix 4.

Research focus area	Main knowledge gaps or research needs	Relevant WABSI research program*	WABSI's research screening framework				
			Research	Management	Policy	Communication	Funding
3	Develop consistent, standardised and robust methodologies for measuring biodiversity • Need for standardised but flexible methods to quantify biodiversity units/gains • Assess the applicability of new technologies (e.g. drones, eDNA, AI, remote sensing) to measure and monitor biodiversity • Identify key biodiversity indicators and develop consistent measurement approaches, such as Indigenous standards (for the nature repair market).	IM	✔				
4	Identify and develop cost-effective, easy-to-apply and robust biodiversity metrics and indicators • Develop standardised metrics for biodiversity measurement • Need for simple but robust biodiversity measurement metrics from farm to regional levels • Find fit-for-purpose indicators tailored to management objectives • Find a small set of key indicators to represent a large portion of biodiversity variations and investigate potential correlates (strong measures).	IM	✔				
5	How to effectively process, integrate and translate existing and newly collected biodiversity data into actionable insights and metrics to inform decision-making • Explore ways to process publicly accessible coarse data into usable formats • Provide access to already collected data in interoperable form • Aggregate existing biodiversity data and apply machine learning to create actionable insights.	IM, RE, UB	✔				✔
Value							
1	Need for robust and practical methodologies for biodiversity valuation • Develop robust approaches, frameworks and cost-effective tools to measure and value biodiversity benefits (including private, public and co-benefits) • Need valuation tools or approaches to inform policy and investment decisions in different land use contexts (e.g. farming vs mining) and scales (e.g. farm vs landscape, single vs multiple species) • Develop tools or frameworks to value biodiversity in multi-functional or multi-objective landscapes (farming and nature, mining and nature).	UB	✔				
2	Understand and integrate diverse non-market values • How to integrate Indigenous perspectives into biodiversity valuation? • How to quantify relational values of biodiversity? • How to appropriately value and incorporate cultural, spiritual, Indigenous and intrinsic values of biodiversity into decision-making processes?	UB	✔				
3	Address the scale and context dependency of biodiversity values • Biodiversity value is context specific. How does the value of biodiversity vary depending on context, the scale of analysis (site-specific, landscape, regional) and the stakeholders involved (developers vs general public)?	UB	✔				
4	Examine the link between biodiversity values and decision-making • Translate biodiversity values into actionable insights for decision-making contexts, such as spatial planning, financial systems and land management • Develop tools and frameworks for biodiversity and natural capital valuation for businesses and others to help in decision-making • Explore the disconnect between the perceived value of biodiversity and willingness to pay or act for conservation.	UB	✔				✔
5	Quantify specific and emerging aspects of biodiversity value • Estimate recreational value of biodiversity and nature • Quantify the health benefits of biodiversity and nature • Value restoration outcomes in agricultural terms (opportunity costs) • Price biodiversity and nature risks for businesses.	IM, RE	✔				
Account for							
1	Develop consistent and interoperable natural capital accounting frameworks • Develop a fit-for-purpose and consistent natural capital accounting framework (aligned with government requirements) that can be applied across different locations, systems, industries, communities and land uses • Find ways to align existing natural capital accounting frameworks to enable comparison.	IM, RE	✔	✔			

* Relevant WABSI programs: RE= Restoration Economy, IM=Data and Information Management, UB=Building Biodiversity for Thriving Urban Ecosystems

(Continued...)

Appendix 4.

Research focus area	Main knowledge gaps or research needs	Relevant WABSI research program*	WABSI's research screening framework				
			Research	Management	Policy	Communication	Funding
2	Improve methodologies for biodiversity or natural capital measurement • How to establish the link between the stock and flow of nature's services? • How to account for the scalability issue in biodiversity measurement and accounting (metric, impacts, dependency) from a site to landscape or vice versa? • Quantify in economic terms the links and interactions between biodiversity and other forms of natural capital like soil and water.	IM	✔				
3	Integrate biodiversity and natural capital into decisions of businesses and public agencies • Identify the barriers and opportunities to integrate biodiversity or natural capital into decision-making • Understand how accounting standards would help to integrate biodiversity and natural capital into corporate decisions • Develop an operational framework to integrate environmental, social and governance considerations into investment decisions • Understand the extent and mechanisms by which primary industries are linked to natural capital.	RE, UB	✔	✔	✔		
4	Develop a natural capital accounting framework that incorporates landscape-scale interactions • Develop a natural capital accounting framework suited to local contexts that aligns with regional, national and international frameworks • Quantify natural capital's contribution to farm productivity, considering the interactions and interlinkages between different assets owned by different owners • Develop tools and approaches to establish cause-effect relationships (response function) of actions and outcomes at farms, including externalities (positive or negative interactions).	IM, RE	✔				
5	Incorporate diverse perspectives and knowledge into developing natural capital accounting • Align with Indigenous and local knowledge in developing or applying the natural capital accounting framework • Include cultural and social perspectives in biodiversity and natural capital accounting.	–	✔				

* Relevant WABSI programs: RE= Restoration Economy, IM=Data and Information Management, UB=Building Biodiversity for Thriving Urban Ecosystems

Research focus area	Main knowledge gaps or research needs	Relevant WABSI research program*	WABSI's research screening framework				
			Research	Management	Policy	Communication	Funding
Enabler							
1	Develop policy framework and de-risking mechanisms to encourage the private sector and individuals to take actions on biodiversity • What are the most effective financial and non-financial incentives to motivate businesses to minimise their adverse impacts on nature and biodiversity? • Identify de-risking mechanisms to increase private sector nature-related investments • What incentive and disincentive structures will motivate reporting and actions on nature-related impacts and dependencies? • Understand the risk appetite of businesses and governments regarding the integration of nature into business models • Develop a coordinated and whole-of-government approach on natural capital and biodiversity.	RE	✔	✔	✔		
2	Create enabling conditions for the design and operation of biodiversity markets • Provide regulatory clarity for biodiversity markets • Find ways to integrate the social and cultural aspects of Indigenous peoples into biodiversity markets • How can biodiversity be stacked or bundled to combine different aspects of nature (biodiversity, carbon, water etc.) within the biodiversity market? • Identify and assess enforcement and governance mechanisms to build trust and confidence in biodiversity markets.	–	✔	✔			
3	Develop and implement clear, consistent and integrated policies and regulatory frameworks to provide certainty and drive action • Identify policy reforms needed to align biodiversity goals with economic development, particularly in sectors like mining and agriculture • Assess and improve existing policies for better biodiversity outcomes • Provide policy certainty for investment in nature and biodiversity and long-term planning • Assess and develop policy coherence across jurisdictions • Develop robust methodologies and frameworks to measure the impact of nature-positive investments.	RE	✔	✔	✔		

* Relevant WABSI programs: RE= Restoration Economy, IM=Data and Information Management, UB=Building Biodiversity for Thriving Urban Ecosystems

(Continued...)

Appendix 4.

Research focus area	Main knowledge gaps or research needs	Relevant WABSI research program*	WABSI's research screening framework				
			Research	Management	Policy	Communication	Funding
4	Facilitate effective cross-sectoral collaboration and integration of Indigenous knowledge systems • Explore effective strategies to promote cross-sectoral collaboration (between industries, government, community and research institutions) • Assess the impact of Indigenous practices on biodiversity outcomes at the site to landscape scale • Integrate and apply Indigenous approaches of measurement, valuation and accounting of natural capital and biodiversity.	–	✔	✔	✔	✔	
5	Understand the drivers of behavioural change and develop the necessary skills and capacity in biodiversity conservation • How can landholders and supply chains be effectively engaged while ensuring equity in risk and reward of biodiversity-positive actions • Develop natural capital expertise and capacity in Western Australia.	–	✔				
6	Integrate biodiversity into all levels of decision-making and land use planning • Find effective incentives and approaches to change human behaviour towards biodiversity conservation • Need for enabling policies to embed biodiversity into local-level decisions • Resolve land tenure and land use issues and mainstream it in land use plans • Develop strategic land use plans and policy interventions.	RE	✔	✔	✔		
Economics							
1	Quantify the economic value and benefits of biodiversity and natural capital • Develop robust methods and models to estimate the economic value of biodiversity, including forecasting models for restoration outcomes • Establish and assess proofs-of-concept or pilots to show that investing in biodiversity conservation is a sound economic case.	–	✔				
2	Understand the costs of biodiversity loss to make biodiversity investment an economic case for action • Quantify the cost of inaction to biodiversity conservation from a long-term perspective (private as well as public) • Assess the long-term economic consequences of biodiversity decline, including reduced ecosystem services or lost ecosystem services like pollination services to farmers.	–	✔			✔	

* Relevant WABSI programs: RE= Restoration Economy, IM=Data and Information Management, UB=Building Biodiversity for Thriving Urban Ecosystems

Research focus area	Main knowledge gaps or research needs	Relevant WABSI research program*	WABSI's research screening framework				
			Research	Management	Policy	Communication	Funding
3	Develop effective market-based mechanisms and incentives for biodiversity conservation • Need to understand the complexities of establishing and operating biodiversity markets, including transaction costs, market failures and incentive compatibility • Understand factors affecting biodiversity certificate and credit demand and supply • Design effective incentives ('carrot and stick') to incorporate natural capital and biodiversity into industry practices or business models.	–	✔	✔	✔		
4	Analyse the interconnections between biodiversity, economic activities and human well-being • Assess the economic link between the state of biodiversity and human health • Estimate any benefits of natural capital investments on improved health outcomes • Lack of value proposition to farmers, businesses and industry to see clear benefits of adopting biodiversity-friendly practices.	–	✔				
5	Address operational challenges in biodiversity conservation • Examine the pros and cons of biodiversity insetting vs trading • Identify cost-efficient ways to conserve biodiversity in agricultural land • Develop frameworks and tools to assess transaction costs associated with biodiversity markets.	–	✔	✔			
6	Improve the integration of biodiversity into economic and policy decisions • Determine ways to integrate biodiversity values into economic and policy decisions • Demonstrate the link between biodiversity protection and positive economic outcomes • Communicate the economic benefits of biodiversity to decision-makers in their decision contexts • Understand the biodiversity risk appetite of governments to identify areas for improvement.	RE, UB	✔		✔		

* Relevant WABSI programs: RE= Restoration Economy, IM=Data and Information Management, UB=Building Biodiversity for Thriving Urban Ecosystems

(Continued...)

Appendix 4.

Research focus area	Main knowledge gaps or research needs	Relevant WABSI research program*	WABSI's research screening framework				
			Research	Management	Policy	Communication	Funding
Market							
1	Understand the demand and supply side of the biodiversity and nature market • Understand and estimate the effective demand for biodiversity certificate and credits, particularly from the private sector • Examine the biodiversity credit market – the extent and quality of demand, who the buyers are and what they are buying • Develop mechanisms to quantify and track demand in specific regions in Western Australia • Understand demand-side and supply-side risks of biodiversity certificates and credits • Develop de-risking approaches to biodiversity market participants • Study supply and demand dynamics of biodiversity markets to learn their future prospects.	RE	✔	✔			
2	Clarify market mechanisms and design • Develop clarity in market design, including how to define what is being protected and for how long • Understand how the biodiversity market works for resources companies that do not have their own land • Demonstrate what a rigorous biodiversity market looks like • Explore ways to make biodiversity an investable asset, or how to translate it into an investable asset.	–	✔	✔			
3	Conduct market analysis and identify price uncertainty • Understand the market and pricing of biodiversity certificates and credits • Conduct price analysis of different ways of creating biodiversity certificates – stacked versus solo certificates • Assess how the composition of biodiversity types affects the value of certificates.	–	✔	✔			
4	Explore integration and applicability of the market across sectors and contexts • Understand which option (insetting or trading biodiversity certificates) is optimal for different landholders in various contexts • Examine how Indigenous approaches to biodiversity management can be linked to the biodiversity market.	–	✔	✔			
5	Evaluate effectiveness, integrity and risks associated with the biodiversity market • Understand the effectiveness of biodiversity offsets, including their genuineness and tenure security • Explore the risks and opportunities associated with different approaches (stacking or bundling) to issuing certificates • Assess the performance of biodiversity compliance (offset) markets • Clarify regulatory approach to natural capital accounting or biodiversity markets in Western Australia.	–	✔				
Finance							
1	Assess the extent, nature and impact of existing biodiversity finance • Explore the extent and type of nature and biodiversity finance in Western Australia • Assess the effectiveness or impact of nature-positive financial instruments, such as green bonds, on biodiversity outcomes • Assess the feasibility and scalability of existing biodiversity targeted financial instruments.	–	✔				
2	Develop and evaluate financial mechanisms and instruments for biodiversity • What are promising nature finance and governance models and instruments that are suitable for Western Australia (revolving fund, philanthropy)? • Explore the potential to create a private exchange (trading platform) for biodiversity • Explore the potential of financial instruments to bundle carbon and biodiversity credits • Develop clarity in financial reward mechanisms for those taking risks and investing in biodiversity and nature • Create a private exchange (trading platform) for biodiversity and develop nature-positive financial instruments for different forms and scales (e.g. species to landscape).	–	✔	✔			
3	Quantify biodiversity value and integrate it into financial decision-making • Find ways to translate biodiversity values into financially viable models for industry • Develop financial models for equitable sharing of risks and rewards between landholders and upstream supply chains • Develop trusted methodologies to quantify the financial value of biodiversity actions for businesses or financial sectors and investors.	–	✔	✔			

* Relevant WABSI programs: RE= Restoration Economy, IM=Data and Information Management, UB=Building Biodiversity for Thriving Urban Ecosystems

(Continued...)

Appendix 4.

Research focus area	Main knowledge gaps or research needs	Relevant WABSI research program*	WABSI's research screening framework				
			Research	Management	Policy	Communication	Funding
4	Understand investor motivations, risk appetite and return expectations • Understand the private sector's motivation (risk avoidance strategy) to biodiversity finance and can these risks be costed • What are the principal drivers of biodiversity investment, such as social licence, reputational risk, legislative risk and material financial risk? • Understand investors' appetite on rate of return in biodiversity-focused investment and their risk profiles (cost, disclosure, regulation, data availability).	RE	✔	✔			✔
5	Identify enabling conditions and overcome barriers to biodiversity finance • Identify what enabling conditions are in place and what additional enablers need to be implemented for biodiversity financing in Western Australia • Assess potential barriers to biodiversity investment, such as the lack of financial incentives for businesses to invest in biodiversity, the perceived high-risk profile of biodiversity projects, and the lack of financial and policy incentives • Assess the robustness of financial instruments and tools, such as biodiversity credits, to generate biodiversity finance.	–	✔	✔	✔		
6	Develop frameworks for environmental, social and governance integration and disclosure related to biodiversity • What type of framework or tool would allow developing environmental, social and governance credentials for business • Assess the significance of financial disclosure by agencies and corporations for Western Australia.	–	✔	✔			
Practice							
1	Develop a natural capital accounting framework and assess its potential to mainstream nature and biodiversity across various sectors in Western Australia • Develop and apply a coordinated natural capital accounting policy framework to mainstream biodiversity and nature into operational decisions across sectors • Clearly define the risk appetite of the financial sector to invest in nature and biodiversity • Avoid misalignments in biodiversity considerations and priorities between different sectors (e.g. mining vs agriculture) • Initiate a shift from the compliance paradigm to a proactive biodiversity stewardship paradigm in all relevant sectors.	RE, IM, UB	✔	✔			
2	Understand the interconnections between major environmental challenges and development • Find ways to balance competing demands on land for different purposes, such as agriculture, housing and other economic activities • Integrate biodiversity into broader environmental and economic goals • Identify integrated strategies to address climate change and biodiversity loss simultaneously.	RE, UB		✔	✔		
3	Develop and evaluate regulatory measures for mainstreaming biodiversity • What types of regulatory measures would be needed to mainstream biodiversity and what is the effectiveness of such measures? • Explore the design, implementation and impact of different regulatory measures across sectors.	RE	✔	✔			
4	Scale up biodiversity initiatives and knowledge • Know how to scale up evidence or findings from one case study to landscape-level or other sites and contexts • How to scale up measurement from a single site for a single species to ecosystem level for multiple species? • How to scale up what is already known by businesses? • How to overcome the 'transferability problem' in biodiversity measurement, valuation and program implementation?	–	✔	✔			
5	Develop practical tools and frameworks for decision-making • Develop tools, frameworks and approaches to embed cultural values and social resilience in biodiversity or natural capital assessments • Find adaptive decision-making tools for a range of operational situations: post mining land use, strategic land use, primary production or farming areas • Generate easy-to-use (applied) information and knowledge suitable for different decision-making contexts • Develop guidance on biodiversity scenarios for Western Australia into the future.	RE, UB	✔	✔	✔		
6	Understand and facilitate effective stakeholder engagement and systemic change • Investigate what systemic changes are needed within industries to integrate biodiversity into long-term land use and development planning • Explore effective engagement mechanisms among stakeholders across sectors to collaborate on biodiversity conservation.	RE, UB		✔	✔		

* Relevant WABSI programs: RE= Restoration Economy, IM=Data and Information Management, UB=Building Biodiversity for Thriving Urban Ecosystems

Appendix 5a.

Workshop 1: Outcomes for the primary production sector, screened by WABSI's research screening framework

Research focus area	Main knowledge gaps or research needs	WABSI's research screening framework				
		Research	Management	Policy	Communication	Funding
Learn						
	• Understand what landholders, growers/farmers can realistically achieve from natural capital and biodiversity in their farms	✔				
	• Need to find no-regret actions that can collectively enhance the South-West region's opportunities, i.e. explore available nature-based solutions that can beneficially be applied	✔				
	• Need opportunities for no-regret actions that benefit both biodiversity and sectors like farming (tourism or public health), e.g. linking drought resilience to biodiversity could enhance farmers' understanding of the value of biodiversity-friendly practices			✔	✔	
	• Need practical guidance on how to integrate biodiversity into existing farming practices	✔				
	• Understand the extent of dependency of different sectors in different components of biodiversity and natural capital quantitatively	✔				
	• Understand the link between natural capital investments and improved health and productivity outcomes at a regional scale (e.g. reduced health costs, green jobs) in the primary production sector.	✔				
Measure						
	• Lack of established baseline biodiversity data	✔	✔			✔
	• Develop a standardised and consistent approach to measure biodiversity at genetic, species and ecosystem levels	✔				
	• Lack of fit-for-purpose data for decision-makers (business, household, industry and region etc.)	✔			✔	
	• Lack of access to existing biodiversity data [Develop mechanism and tools that allow access to existing data to gain insights for decision-making] and issues of data inaccessibility, transferability and application	✔	✔		✔	
	• Lack of reliable benchmarks (baseline) for progress monitoring	✔	✔			
	• Lack of tools to forecast biodiversity outcomes of actions [this involves understanding response functions in relation to intervention and outcomes]	✔	✔		✔	
	• Lack of standardised methods to quantify biodiversity units and gains [this relates to the need for consistent and robust biodiversity indicator, metric and measurement approaches]	✔				
	• Lack of standardised methods for biodiversity trading	✔	✔			
	• Need for cost-effective technologies to gather granular data at farm (landholder) level (e.g. to measure biodiversity on the ground)	✔	✔			
	• Need to focus on monitoring and ensuring continuity of data		✔	✔		✔
	• Need to focus on improving data access and standardising measurement tools for biodiversity and natural capital	✔	✔			
	• Need to find a balance (trade-off) between perfect and practical metrics.	✔	✔			
Value						
	• How to value restoration outcomes in agricultural terms (relative to agricultural outcomes) remains a challenge	✔	✔			
	• Need approaches to value biodiversity in the context of the government's shift towards restoration and carbon and ecosystem service markets	✔				
	• Lack of tools to value biodiversity in multi-functional, multi-objective landscapes, e.g. carbon, farming, natural capital accounting etc.	✔	✔			
	• Landholders are uncertain about the value and practical integration of biodiversity and natural capital into farming.	✔	✔			
Account for						
	• Lack of assessment (or quantification) of the dependency of different primary production sectors (agriculture, livestock, horticulture) on biodiversity and natural capital	✔	✔			
	• Lack of fit-for-purpose, consistent but flexible frameworks to account for the role of biodiversity according to specific needs of location and system, industries, communities and land uses	✔		✔		
	• Need long-term monitoring program to track biodiversity changes over time.			✔		✔
Enabler						
	• Need cross-sectoral collaboration – government, industry, community – in biodiversity conservation (to understand, measure, value and finance) and natural capital accounting	✔	✔	✔		
	• Develop a consistent operational framework to enable benefits of biodiversity conservation and nature protection to reach communities	✔			✔	
	• Need considerations on how to engage landholders and service providers while ensuring equity in risk and reward of investing in biodiversity and nature		✔		✔	
	• Identify priority areas of collaboration with government, industries (Meat & Livestock Australia, as an example) and NRM sectors		✔		✔	
	• Need regional coordination to pilot potential biodiversity projects in specific regions (e.g. south-west of Western Australia) as a foundation to develop a broader biodiversity market	✔			✔	
	• Need to align long-term goals (vision) with practical, short-term financial and actionable outcomes		✔	✔		✔

(Continued...)

Appendix 5a.

Research focus area	Main knowledge gaps or research needs	WABSI's research screening framework				
		Research	Management	Policy	Communication	Funding
	• Need for government support (de-risking approach) to reduce investment risks for the private sector	✔	✔	✔		
	• Provide regulatory clarity (policy certainty) for biodiversity markets			✔		
	• Assess resource needs to bring long-term changes in biodiversity and natural capital and to alter landholder behaviour		✔		✔	
	• Need to address the gap in natural capital expertise and capacity in Western Australia		✔		✔	✔
	• Explore successful working models in natural capital from other states or countries					
	• Need to invest in long-term monitoring programs that can track the effectiveness of biodiversity initiatives and support evidence-based decision-making	✔	✔			✔
	• Government needs to play an active role in creating regulatory frameworks and supporting the development of natural capital markets.		✔	✔		
Economics						
	• Lack of forecasting models and methods to value restoration outcomes	✔				
	• Need to quantify the financial and economic benefits of biodiversity change over time	✔				
	• What is the cost of inaction?	✔				
	• Explore the role of insetting – what would be the impact of insetting by agriculture and NRM sectors on the biodiversity (certificate) market?	✔				
	• Need research on long-term economic benefits of investing in biodiversity and natural capital	✔				
	• Need to understand the connection between natural capital investments and improved health outcomes (reduced costs of health care)	✔			✔	
	• How can we quantify the long-term economic benefits of biodiversity and natural capital investments?	✔				
	• What do we know about cost-efficiency for farmers to switch from current practice to biodiversity-focused agricultural (or other) practices?	✔	✔			
Market						
	• Farmers consider the carbon or biodiversity market to diversify income; there is reluctance to shift focus entirely away from farming (explore integrated approaches to conserve biodiversity in existing farming practices)	✔	✔			
	• Need advocacy and leadership on biodiversity market development in the NRM sector	✔	✔			
	• Market for biodiversity is emerging but still lacks a clear value proposition for Western Australian stakeholders – what is demanded and what can be supplied, what to trade, to whom, and what are trade-offs?	✔				

Research focus area	Main knowledge gaps or research needs	WABSI's research screening framework				
		Research	Management	Policy	Communication	Funding
	• What is the current demand for biodiversity credits in Western Australia, and how can this demand be quantified and tracked?	✔				
	• Need to develop a viable biodiversity credit trading system for Western Australia		✔	✔		
	• Which option and in what context between insetting or selling the biodiversity certificate would be optimal for landholders and farmers?	✔				
	• Need to conduct a market analysis to understand supply and demand dynamics of biodiversity credits	✔				
	• Need ways to integrate supply and demand dynamics into existing market mechanisms or frameworks	✔				
	• Need to conduct research to understand the demand for biodiversity credits.	✔				
Finance						
	• Need financial incentives and clear value proposition to encourage landholders to participate in the biodiversity market (develop field demonstration or pilot projects to show what things look like)	✔				✔
	• Develop financial models for equitable sharing of risks and rewards between landholders (who bear the risks) and upstream supply chains (who reap the rewards)	✔	✔			
	• Need to ensure continuity of investment in long-term natural capital accounting		✔			✔
	• Need to ensure funding sources for natural capital projects, and how to reduce the risk of investment in such projects	✔	✔			✔
	• Need to examine whether inconsistent measurement tools are a barrier to biodiversity investment	✔	✔			
	• Need to address the imbalance in risk-reward distribution and ensure long-term financial sustainability for biodiversity and natural capital projects.	✔	✔			
Practice						
	• Find a balance between bottom-up and top-down ways of thinking about biodiversity measurement, financing and mainstreaming	✔	✔	✔		
	• Need a prospective analysis to estimate costs to Western Australia's economy of inaction or not investing in nature or mainstreaming nature and biodiversity into decision-making	✔		✔		
	• Need clear financial incentives for landholders to engage in biodiversity projects, particularly in areas where benefits accrue in the long-term or are abstract in nature	✔			✔	
	• How can farmers or landholders align natural capital projects with government priorities and processes to minimise regulatory risk? Need policy framework or guidance.	✔				

Appendix 5b.

Workshop 1: Outcomes for the resources sector, screened by WABSI's research screening framework

Research focus area	Main knowledge gaps or research needs	WABSI's research screening framework				
		Research	Management	Policy	Communication	Funding
Learn						
	• Need to effectively apply and scale up restoration and biodiversity conservation efforts with a focus on long-term climate adaptation		✔			
	• Need to develop robust and effective strategies to balance biodiversity conservation with land use priorities (i.e. learn from global case studies as well, such as from Brazil)	✔	✔			
	• Explore innovative restoration techniques, especially considering the changing climate and the need for species adaptation	✔				
	• Understand how to efficiently expand key opportunities such as land restoration efforts, enhanced seed banks and better managed lands for long-term biodiversity improvements	✔	✔			
	• Understand the risk of moving too fast without sufficient regulation or policy certainty, which could undermine biodiversity efforts and discourage investment			✔		
	• Need to know ways to bridge the gaps between technical and community understanding of biodiversity, which is essential for broader adoption of practices and interventions	✔				
	• Understand the role of technology (e.g. remote sensing or new technologies) in improving biodiversity monitoring	✔	✔			
	• Need to know how to improve the effectiveness of restoration projects, particularly in areas with limited ecological knowledge	✔				
	• Understand how biodiversity conservation strategies can be adapted to address the challenges of climate change, particularly with shifting species	✔	✔			
	• Explore ways to design biodiversity projects that can accommodate and consider both current and future climatic conditions.	✔	✔			
Measure						
	• Identifying priority metrics for biodiversity is complex, as not everything can be measured, thus the focus needs to be on key and impactful elements	✔				
	• The methodology for measuring biodiversity is uncertain, especially as it varies across regions and sectors (e.g. terrestrial vs aquatic) – need a defined but flexible approach	✔				
	• There is a need for consistent and standardised methods for measuring biodiversity for accounting and regulatory purposes (need for frameworks, tools and guidance)	✔	✔			
	• While significant data exists on biodiversity and ecosystems, there is a gap in translating this data into actionable insights and metrics, especially for aquatic ecosystems				✔	
	• There is a risk of implementing biodiversity strategies without clear methodologies or metrics to measure success, leading to ineffective or costly outcomes	✔	✔			
	• Need to develop a standardised approach to measure biodiversity that works across sectors and regions, which is a key challenge	✔				
	• Data uncertainty and gaps in research (especially for aquatic ecosystems) make it difficult to quantify biodiversity impacts accurately	✔				
	• Need to identify the most critical gaps in biodiversity data and ways to address them through research and innovation	✔				
	• Develop standardised metrics to measure biodiversity across different ecosystems.	✔				
Value						
	• Difficulty in valuing biodiversity in financial terms, especially in conveying these values to investors or decision-makers who may not fully understand or prioritise it	✔			✔	
	• Need holistic approach to valuation that would capture economic, cultural and religious values of biodiversity to society	✔				
	• The complexity of valuing biodiversity in dollar terms creates challenges in justifying investment to stakeholders and decision-makers	✔				
	• The complexity of assessing ecosystem services, including intangible values like cultural or spiritual significance, complicates the assessment (or measurement) process	✔				
	• Need the most effective approaches to value biodiversity in monetary terms for decision-making.	✔				
Account for						
	• Natural capital accounting offers significant potential for incorporating biodiversity into financial planning, with potential to attract private sector investment in biodiversity initiatives	✔	✔			
	• Need to embrace the opportunity to embed natural capital accounting into systems like environmental impact assessments to demonstrate practical, measurable biodiversity outcomes		✔	✔		
	• Need to foster landscape-scale approaches to restoration, including partnerships between governments, landowners and local communities, which can drive biodiversity outcomes across regions		✔	✔		
	• What are the best practices for designing and implementing biodiversity offsets that are both effective and equitable?	✔	✔			

(Continued...)

Appendix 5b.

Research focus area	Main knowledge gaps or research needs	WABSI's research screening framework				
		Research	Management	Policy	Communication	Funding
Enabler						
	• Existing policies often fail to account for biodiversity appropriately, and rapid policy changes can complicate long-term planning and investment [need for policy inclusion and certainty]	✔	✔	✔		
	• The speed of policy change often outpaces industry's ability to implement, creating risks of regulatory misalignment			✔		
	• Policy uncertainty around biodiversity offsets and how to integrate them into land use planning remains a major barrier.	✔	✔	✔		
	• Need for collaboration across sectors (mining, agriculture etc.) to achieve biodiversity outcomes, but aligning different interests remains challenging	✔	✔			
	• The potential for Western Australia to position itself as a global leader in biodiversity restoration and natural capital management exists, especially given its natural resources and expertise in land management.		✔			
	• Need a better collaboration between industries, government and research institutions to share knowledge and scale restoration efforts	✔	✔			
	• Need a better leveraged policy to drive industry action, with clear, simplified rules and incentives for biodiversity conservation (e.g. through offset mechanisms or restoration funding)	✔		✔		
	• Need a strategic land use plan and policy interventions, which can help enhance biodiversity, including the establishment of biodiversity corridors or securing land for conservation	✔	✔			
	• Need to integrate social science into biodiversity initiatives that can help change attitudes and drive public engagement through community-driven efforts	✔	✔			
	• Need a long-term perspective – the political cycles and short-term focus may delay or complicate the adoption of long-term biodiversity strategies		✔	✔		
	• What policy reforms are needed to align biodiversity goals with economic development, particularly in industries like mining and agriculture?	✔				
	• Government needs to create policies that incentivise private sector investment in biodiversity conservation.	✔		✔		
Economics						
	• There is a need to assess collective impacts of (resource projects) on biodiversity and associated values (benefits and costs) to society (say, health benefits as well)	✔	✔			
	• Need proof-of-concept that investing in biodiversity and nature is a sound economic case	✔				
	• Farmers, businesses and industry players need to see clear benefits to adopting biodiversity-friendly practices		✔			
	• Communicate the economic benefits of biodiversity, such as ecosystem services, to decision-makers in the context of their decision environment.				✔	

Research focus area	Main knowledge gaps or research needs	WABSI's research screening framework				
		Research	Management	Policy	Communication	Funding
Market						
	• How can market-based approaches, such as biodiversity credits, help drive demand for biodiversity-positive products?	✔				
	• What role can technological innovations (e.g. blockchain, digital platforms) play in improving transparency in biodiversity markets?	✔				
	• How can biodiversity markets be made financially viable and scientifically credible?	✔				
Finance						
	• Investors are increasingly demanding biodiversity considerations, but there is a lack of trusted methodologies to quantify the financial value of biodiversity actions.	✔	✔			
	• There are barriers to success in translating biodiversity values into financially viable models for industry, especially when the regulatory framework is still developing or less clear.	✔	✔			
	• The lack of financial incentives for businesses to invest in biodiversity poses a risk of stagnation in the sector.	✔	✔			
	• The perceived high-risk profile of biodiversity projects could deter investors unless clear financial returns can be demonstrated.		✔			
	• Scaling up biodiversity restoration requires significant investment in training, capacity building and research to ensure that methods are effective and sustainable.		✔			✔
	• Need to identify roles for local communities and farmers in driving biodiversity restoration, and how they can be incentivised.	✔	✔		✔	
	• Need to identify financial mechanisms that can be developed to encourage private investment in biodiversity conservation.	✔				
Practice						
	• How can we consolidate existing biodiversity research to create a robust evidence base for decision-making?				✔	
	• There is a tension between the practicality of implementing biodiversity conservation initiatives and achieving significant environmental outcomes.		✔			
	• High-risk projects may be needed for large-scale changes, but mainstreaming (biodiversity) adoption requires reducing the project risk profile to attract investors.		✔			
	• Need for future-proofing policies (policy certainty) to accommodate climate change and restoration goals, which will be essential to maintaining biodiversity in the long term	✔		✔		
	• Need for mainstreaming biodiversity into broader environmental and economic goals to build a more resilient and sustainable system	✔	✔			

(Continued...)

Appendix 5b.

Research focus area	Main knowledge gaps or research needs	WABSI's research screening framework				
		Research	Management	Policy	Communication	Funding
	• Increasing interest in biodiversity from investors provides an opportunity to make biodiversity a mainstream consideration in decision-making.	✔	✔			
	• Policy changes that lack coordination across levels of government (e.g. federal vs state) could create confusion or unintended consequences for businesses and landholders.			✔		
	• Misalignment in biodiversity considerations between sectors (e.g. mining vs agriculture) could result in competing priorities and slowing progress.		✔			
	• Biodiversity restoration may not be adequately scaled up due to funding, knowledge gaps or regulatory barriers.		✔	✔		
	• Aligning biodiversity goals with other social and economic priorities (e.g. housing, tourism, public health) will be a critical challenge.	✔	✔			
	• The challenge lies in integrating land use practices with a focus on social and economic priorities (e.g. agriculture, housing) and biodiversity conservation in the face of competing demands on land.	✔	✔			
	• Need effective engagement mechanism or approach among stakeholders across sectors to collaborate on biodiversity conservation goals		✔		✔	
	• What systemic changes are needed within industries to integrate biodiversity into long-term land use and development planning?	✔	✔			
	• Need for a shift from the current compliance-driven paradigm to proactive biodiversity stewardship within and across sectors.		✔			

Appendix 5c.

Workshop 1: Outcomes for the services sector, screened by WABSI's research screening framework

Research focus area	Main knowledge gaps or research needs	WABSI's research screening framework				
		Research	Management	Policy	Communication	Funding
Learn						
	• How to achieve nature-positive outcomes where human activities interact with biodiversity recovery in different contexts?	✔				
	• Need to know different methods to improve biodiversity assessment using pilot projects based on eDNA or other new technologies	✔				
	• Demonstrate successful case studies that can help attract both public and private sector investment in nature and biodiversity conservation	✔				
	• Need to use case studies and pilot projects to show economic and ecological benefits of biodiversity conservation to gain political support	✔				
	• How to connect the public with nature to increase conservation awareness and actions?	✔	✔			
Measure						
	• There are issues with the quality, accessibility and consistency of biodiversity data.	✔	✔			
	• Lack of state-level vegetation mapping		✔			
	• Poor consolidation of data across sectors	✔	✔			
	• Inefficiency in data generation and sharing	✔	✔			
	• Data generated by government and private entities are not interoperable or standardised, complicating measurement and reporting of biodiversity.	✔	✔			
	• Lack of baseline data on biodiversity, making it difficult to assess the effectiveness of conservation efforts	✔	✔			
	• The quality of the available data, particularly around biodiversity metrics, is inconsistent and varies across Western Australia's regions		✔			
	• Lack of standard metrics to measure biodiversity	✔	✔			
	• Lack of consensus on metrics to measure biodiversity	✔	✔			
	• Need for standardisation of biodiversity metrics, especially at the state level, which would facilitate better measurement, reporting and decision-making	✔	✔			
	• Creating shared databases of biodiversity data, similar to Queensland's ecosystem mapping, can make data more accessible and reliable.		✔			

(Continued...)

Appendix 5c.

Research focus area	Main knowledge gaps or research needs	WABSI's research screening framework				
		Research	Management	Policy	Communication	Funding
	• How can we improve the consistency and quality of biodiversity data, particularly in relation to emerging technologies like eDNA?	✔				
	• What are the challenges of reconciling observational data with inferred decision-making processes?	✔	✔			
	• What is the true baseline for biodiversity, especially considering climate change and human activities?	✔	✔			
Value						
	• Available biodiversity data is insufficient/inadequate, making it difficult to value biodiversity accurately.		✔			
	• The intrinsic value of nature and biodiversity is not well understood or integrated into decision-making.	✔				
	• Lack of standard metric to measure biodiversity complicates valuation of biodiversity.	✔				
	• Challenges in integrating biodiversity valuation with financial systems – particularly when considering the cost of inaction (e.g. loss of ecosystem services)	✔	✔			
	• Need a consistent approach/framework to value biodiversity	✔				
	• It's challenging to quantify intrinsic value (importance of biodiversity on its own) and relational values of biodiversity and nature, such as cultural or spiritual importance, which are often disregarded in economic models.	✔	✔			
	• Often a disconnect between public perception of biodiversity value and the actual on-the-ground actions required	✔	✔			
	• Challenge in measuring social and cultural values (e.g. public opinion, cultural importance) and making them actionable in financial and policy frameworks	✔				
	• Increasing awareness of the relational and social value of nature is critical for shifting public perception.	✔	✔		✔	
	• Using media and community engagement strategies, like place-based approaches to biodiversity valuation, can help raise the profile of biodiversity issues.				✔	
	• How can we better quantify the value of urban nature and the impacts of biodiversity loss in cities (e.g. the economic and social value of tree canopy)?	✔				
Account for						
	• There are multiple frameworks to measure and account for biodiversity and nature, but they are not well aligned, making it difficult to make accurate comparisons or assess progress over time [need inter-operability across the frameworks, if different frameworks are used].	✔	✔			
	• Capturing Indigenous and local knowledge in the natural capital accounting process is essential but often overlooked.	✔	✔			

Research focus area	Main knowledge gaps or research needs	WABSI's research screening framework				
		Research	Management	Policy	Communication	Funding
	• Lack of inclusion of cultural and social perspectives in biodiversity measurement, valuation and accounting, which is crucial for an effective and holistic understanding of biodiversity and ecosystem services	✔	✔			
	• There's a need for a consistent approach/framework to accounting and reporting biodiversity.	✔				
	• Various organisations are using different frameworks for natural capital accounting. Either we need a common framework or the way to link/communicate/compare information between different frameworks (interoperability) [Lack of common framework for natural capital accounting].	✔	✔			
	• A regional approach to natural capital accounting could provide a foundation for standardised, government-supported data across sectors, making it more cost-effective. Implementing regional natural capital accounting frameworks and aligning them with national and global targets (e.g. TNFD) could streamline data collection, reporting and financing.	4	✔			
	• Need transparent and standardised reporting mechanisms for biodiversity impacts and financial returns of businesses that will help attract more investment.	✔		✔		
Enabler						
	• Policies are fragmented, with a focus on sectors like mining, leaving biodiversity largely unaddressed in a cohesive manner.			✔		
	• Need ways to integrate Indigenous knowledge into official biodiversity frameworks (measurement, valuation, accounting), but finding ways to do so requires collaboration and respect for local knowledge systems.	✔	✔			
	• Need to develop methodologies that link environmental improvements directly to social and economic outcomes.	✔	✔			
	• Governments must develop and promote policies that encourage co-investment and allow for flexible mechanisms, such as hybrid offsetting models or green bonds, to support nature-positive initiatives.			✔		✔
	• Political challenges (in Western Australia), with the dominant focus on industries like mining, and societal resistance to changing long-standing practices, may slow the adoption of biodiversity conservation policies.		✔	✔		
	• Government-backed concessional loans and risk-sharing models can lower barriers to private sector participation in conservation.	✔				✔
	• Social nudges and educational campaigns for biodiversity and nature can drive behavioural change and increase public support for policy shifts.	✔		✔		
	• Government and private sector collaboration will be crucial in making the natural capital accounting frameworks actionable.		✔			
	• Securing commitments from both regulators and large corporations for biodiversity and natural capital accounting is vital.		✔		✔	

(Continued...)

Appendix 5c.

Research focus area	Main knowledge gaps or research needs	WABSI's research screening framework				
		Research	Management	Policy	Communication	Funding
Economics						
	• Quantify the cost of not protecting biodiversity, in terms of lost ecosystem services (e.g. coastal protection, flood regulation)	✔	✔			
	• Demonstrate the economic, ecological and social benefits of nature-positive actions	✔	✔			
	• Develop a financial value proposition for biodiversity, including the cost of inaction, to integrate it into economic planning and decisions		✔			✔
	• Quantify the cost of inaction, particularly in terms of ecosystem services (e.g. loss of tree canopy, pollination).	✔	✔			
Market						
	• The risk of continued biodiversity loss could lead to significant economic consequences, particularly in sectors like agriculture, where pollination and soil health are vital.	✔	✔			
Finance						
	• Need for policymakers to negotiate with businesses and investors to address the biodiversity finance gap			✔		✔
	• Lack of financial and policy incentives to drive private and public investment in biodiversity conservation	✔		✔		
	• Existing approach to biodiversity financing is highly fragmented; there is a need for integrated approach to finance biodiversity conservation.	✔				✔
	• Need more robust financial instruments and tools, such as biodiversity credits, to bring in capital for long-term biodiversity conservation	✔	✔			✔
	• The financial community struggles to price biodiversity risks and integrate nature-related financial disclosures into business models.	✔				
	• Financial uncertainty limits investment in biodiversity conservation projects, delaying the adoption of nature-positive approaches.		✔			✔
	• Green bonds, biodiversity credits and ecosystem service payments present significant opportunities for financing biodiversity initiatives.	✔	✔			
	• By bundling carbon and biodiversity credits together, these instruments and tools (green bonds, biodiversity credits, payment for ecosystem services) can drive investment in conservation and sustainable land management practices.	✔	✔			
	• The involvement of the public and private sectors in funding and data generation will be crucial for building sustainable biodiversity financing mechanisms.	✔	✔			✔
	• Need to learn from insurance companies that can provide valuable insight into how biodiversity risks (e.g. species extinction, habitat loss) can be priced into financial products	✔	✔			
	• Developing new financial instruments, such as green bonds or biodiversity-based insurance products, can provide the necessary funding for biodiversity initiatives.	✔		✔		✔
	• What are the potential alternatives to traditional biodiversity offsetting, such as hybrid models or region-specific approaches?		✔			
	• Build flexibility into biodiversity financing mechanisms to local contexts.	✔				
Practice						
	• Cost of biodiversity loss is often not factored into business or government decision-making.	✔		✔		
	• How can we effectively quantify and integrate public perception of biodiversity values into the decision-making process?	✔		✔		
	• Disconnect between national and state policies, with a lack of commitment to integrating biodiversity into broader economic and financial systems	✔	✔	✔		
	• Need to align local, national and international biodiversity targets to achieve expected outcomes	✔	✔	✔		
	• Need clear actions from both the public and private sectors for biodiversity to be considered a mainstream issue.	✔	✔	✔		

Appendix 5d.

Workshop 1: Outcomes for the financial sector, screened by WABSI's research screening framework

Research focus area	Main knowledge gaps or research needs	WABSI's research screening framework				
		Research	Management	Policy	Communication	Funding
Learn						
	• There is no consensus on what these terms (no net loss, net gain) mean for financial markets, creating confusion in policy and implementation.			✔	✔	
	• Failure to understand and act on ecosystem tipping points could lead to irreversible biodiversity loss, with cascading effects on Western Australia's natural capital and economy.	✔	✔			
	• Understand the effectiveness of education-focused, awareness-raising activities on the role of biodiversity to human well-being and the impact of such activities on biodiversity outcomes	✔	✔			
	• Implement large-scale longitudinal surveys on public attitude to biodiversity to inform relevant public policy	✔				
	• Need to know sub-sovereign treasury functions in Australia [UK, Canada] in the context of how they approach biodiversity, starting with New South Wales Treasury, to capitalise on lessons learned.	✔				
Measure						
	• Environmental or biodiversity data is fragmented.		✔			
	• There is a challenge or significant hurdle of accurately measuring biodiversity, defining clear baselines and tracking changes over time.	✔				
	• Understanding ecosystem tipping points is crucial but underdeveloped in current decision-making frameworks.	✔				
	• Existing data on biodiversity and ecosystem services is underused due to lack of integration, privacy concerns and regulatory restrictions.	✔				
	• Western Australia lacks a centralised, independent authority to establish and track baseline biodiversity metrics.	✔	✔			
	• The absence of clear privacy legislation around environmental data, and concerns about data misuse, hinder effective data sharing, particularly in industries like mining.		✔	✔		
	• There's an opportunity to aggregate existing environmental data and apply machine learning to create actionable insights and track biodiversity changes more effectively.	✔	✔			
	• Creating a clear and independent baseline for biodiversity, using data from agencies like the Australian Bureau of Statistics or the United Nations' System of Environmental-Economic Accounting, will help in tracking progress and guiding decision-making.	✔	✔			

Research focus area	Main knowledge gaps or research needs	WABSI's research screening framework				
		Research	Management	Policy	Communication	Funding
Value						
	• There's a limited understanding of the true value of biodiversity.	✔			✔	
	• Valuing ecosystem tipping points is crucial but underdeveloped in current decision-making frameworks.	✔				
	• Lack of approaches to price nature risks to businesses	✔				
	• Find cost-effective ways to integrate nature risks into economic modelling.	✔				
Account for						
	• Efforts like the Australian Bureau of Statistics' natural capital accounting and the United Nations' System of Environmental-Economic Accounting could play a role but need more attention and integration with Western Australian contexts.	✔	✔			
	• Developing a robust risk management framework that includes biodiversity risks could provide clear guidance for businesses and government agencies, helping them make informed decisions.	✔	✔			
	• Adopt frameworks that align well with the global environmental, social and governance standards.	4	✔	✔		
	• Show how nature-based solutions can reduce risk and provide long-term benefits.	✔				
Enabler						
	• There is insufficient government funding and capacity to support biodiversity measurement and valuation, policy implementation and long-term planning.		✔			✔
	• Government policies do not align well with the private sector's needs, especially in terms of incentivising biodiversity conservation or sharing risks.	✔	✔	✔		
	• There's no unified approach to understanding and managing biodiversity risks within corporations or government agencies.	✔	✔			
	• Regulatory, reputational and financial risks are arising for companies not managing biodiversity risks.	✔	✔			
	• Without clear definitions and policies, such as on 'no net loss', there is a risk of ineffective environmental actions or inaction, which could affect Western Australia's international reputation.		✔			
	• Educating the public and industry about the value of biodiversity and ecosystem services could shift the market and policy context towards more sustainable practices.	✔			✔	
	• Framing biodiversity protection as a strategic advantage to businesses could incentivise them to participate in conservation actions.		✔			✔
	• Framing biodiversity conservation as a form of insurance against climate and environmental risks could appeal to both the public and businesses, positioning conservation as a cost-effective, proactive strategy for the future.	✔	✔	✔	✔	

(Continued...)

Appendix 5d.

Research focus area	Main knowledge gaps or research needs	WABSI's research screening framework				
		Research	Management	Policy	Communication	Funding
Economics						
	• Lack of integration of biodiversity values into economic and policy decision-making	✔	✔			
	• The link between biodiversity, its value and economic outcomes is not presented in a connected way that shows how protecting nature and biodiversity is contributing to economic outcomes.	✔				
	• Public and government understanding of biodiversity as a public good – something valuable for society – is potentially lacking, affecting policy and framework development and financial investment.	✔	✔			
	• Failing to address biodiversity decline may lead to economic losses, especially in sectors like agriculture, tourism and resource extraction, which rely on healthy ecosystems.	✔	✔			✔
	• Failure to conserve biodiversity in Western Australia would risk or increase long-term social and economic costs arising from different sources, including reduced ecosystem services (e.g. pollination, water filtration) and exacerbated climate change impacts.	✔	✔	✔		
	• Assess the component of biodiversity risk appetite of the government (with a focus on different aspects of biodiversity) and retrofit the existing contexts to find areas for improvement.	✔	✔			
Market						
	• There are challenges in ensuring biodiversity offsets are genuine and effective, with concerns over future tenure security and fraud.		✔			
Finance						
	• Biodiversity finance is an issue because funding is insufficient for long-term biodiversity protection.	✔	✔			
	• There's no clear definition of the government's risk appetite regarding biodiversity loss.	✔	✔			
	• Focus of financial institutions on environmental outcomes is increasing but inadequate (e.g. stakeholders like investors, banks and insurers are increasingly focused on environmental outcomes).		✔			
	• There is a lack of adequate financial products and instruments in the financial system (insurances, banking, asset management etc.) that reward pro-conservation behaviour.	✔				
	• There is also a need to assess the impact of available financial products (e.g. concessional loan, green bonds etc.).	✔				
	• Developing new financing models (e.g. green bonds, biodiversity credits) to fund biodiversity projects could create a sustainable funding stream for conservation efforts.	✔				✔
	• Using environmental data for social licence and reputational benefits can drive investment and public support for biodiversity projects.	✔	✔			

Research focus area	Main knowledge gaps or research needs	WABSI's research screening framework				
		Research	Management	Policy	Communication	Funding
Practice						
	• Current government policies around environment and incentivising actions (e.g. conservation acts) are outdated and lack effective execution.			✔		
	• Need (financial) policy modification to focus on long-term environmental goals			✔		
	• Need coherence in policy decisions between immediate economic goals (e.g. growth, inflation) and long-term sustainability and conservation goals.		✔	✔		
	• There is insufficient policy to manage and aggregate (financial) data effectively for environmental decision-making.	✔	✔	✔		
	• Need to define or establish risk appetite for biodiversity in the financial system	✔	✔			✔
	• Lack of clearly defined biodiversity risk appetite results in a lack of policy or frameworks to manage this risk effectively.			✔		
	• Short-term policy goals often undermine critical environmental actions.			✔		
	• Need to build stronger collaborations between government, business and investors to align their actions around biodiversity protection and financial risk management.	✔	✔			
	• There is an opportunity to revise existing policies and create new ones (in Western Australia) that prioritise long-term biodiversity conservation, integrate nature into economic planning and address climate change.	✔	✔	✔		

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