MAPPING BIODIVERSITY PRIORITIES

A practical, science-based approach to national biodiversity assessment and prioritisation to inform strategy and action planning

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MAPPING BIODIVERSITY PRIORITIES: A QUICK OVERVIEW

A practical, science-based approach to national biodiversity assessment and prioritisation to inform strategy and action planning

Purpose

Spatial data and mapping can provide multiple benefits for biodiversity strategies and action planning at a national scale. However, few countries include any spatial data strategies in their National Biodiversity Strategies and Action Plans (NBSAPs).

This document sets out a practical, science-based approach to spatial biodiversity assessment and prioritisation. It shows how it is possible to use available spatial data to conduct a useful national assessment of biodiversity in a short space of time and with minimal resources.

Key questions

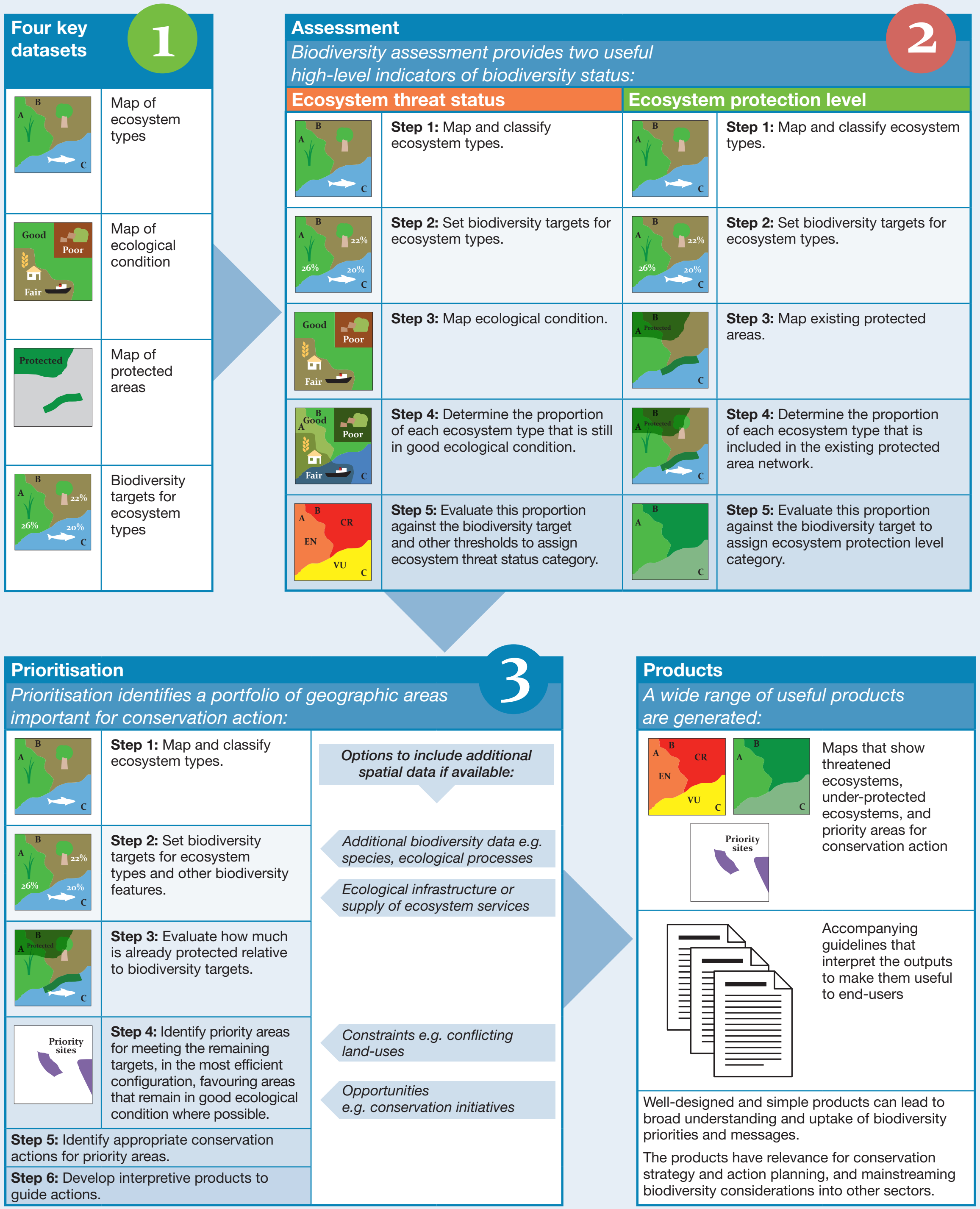
Answering three key questions about biodiversity can be useful for a range of policy, strategy and action planning:

1. What biodiversity does a country have and where is it?
2. What is the state of the biodiversity across the landscape and seascape?
3. Where and how should a country act first to manage and conserve biodiversity?

Guiding principles

The approach is based on the principles of Systematic Conservation Planning and augmented by several operating principles:

1. Aim to conserve a viable representative sample of every different type of biodiversity.
2. Aim to conserve key processes that allow biodiversity to persist over the long-term.
3. Set quantitative biodiversity targets to achieve representation and persistence.
4. Use the best available science to ensure robust, defensible and credible results.
5. Aim for consistency across terrestrial, inland water, coastal and marine realms.
6. Use an adaptive approach: start simply and plan for iterative improvements.
7. Keep the process simple, with clear and understandable outputs.
8. Make a clear link to implementation by remaining aware of the policy context.
9. Be appropriately inclusive and engage stakeholders at relevant stages.
10. Make the products easily accessible for wide use.



Preface

Spatial data and mapping can provide multiple benefits for biodiversity strategies and action planning at a national scale, such as determining the state of biodiversity in a country, identifying national priority areas, monitoring progress towards international targets, and visually communicating key biodiversity issues. For this reason, parties to the Convention on Biological Diversity (CBD) have been urged to use their revised National Biodiversity Strategies and Action Plans (NBSAPs) as an instrument to integrate biodiversity information into spatial planning processes by governments and the private sector.

In 2014, UNEP-WCMC published a guidance document to support the preparation of updated NBSAPs that incorporated spatial data and mapping[1]. However, it has been recognised that countries need further ongoing guidance on spatial assessment and prioritisation of their biodiversity. This was confirmed by a recent survey of teams involved in the revision of NBSAPs, in which as many as 20 countries, out of 50 responses, stated that they had not included any spatial data in their updated NBSAPs.

The National Biodiversity Assessment (NBA) of South Africa is often cited as a useful approach to incorporating science-based spatial data into NBSAPs. The South African National Biodiversity Institute (SANBI), which leads the NBA, is frequently contacted for information on how this approach was developed and applied. Discussions between UNEP-WCMC and SANBI initiated the joint development of this document to distil and share the experience and key lessons learned from South Africa's approach to spatial biodiversity assessment and prioritisation. Particular emphasis was put on providing guidance appropriate for countries that are resource and data constrained. This document is the result of an expert writing workshop convened by UNEP-WCMC and SANBI at Kirstenbosch National Botanical Garden, South Africa, in September 2015. Core members of the NBA team, and others with relevant expertise, were brought together to identify and write-up the essential components for conducting spatial biodiversity assessment and prioritisation.

This document shows how a few basic datasets can be combined to produce useful headline indicators of the state of biodiversity and map products that help to focus and prioritise conservation action across the landscape and seascape, at the country level. This information can be used to inform a wide range of policy applications, including but not limited to NBSAPs.

[1] Bowles-Newark, N. J., Arnell, A. P., Butchart, S., Chenery, A., Brown, C., Burgess, N. D. 2014. Incorporating and utilising spatial data and mapping for NBSAPs: Guidance to support NBSAP Practitioners. UNEP-WCMC, Cambridge, UK. http://www.unep-wcmc.org/resources-and-data/incorporating-and-utilising-spatial-data-and-mapping-for-nbsaps

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The United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) is the specialist biodiversity assessment centre of the United Nations Environment Programme (UNEP), the world's foremost intergovernmental environmental organisation. The Centre has been in operation for over 30 years, combining scientific research with practical policy advice.

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Executive Summary

In almost any country, and in almost any policy context, there are certain fundamental questions that need to be answered to inform biodiversity policy, strategy, and action planning. Assessing biodiversity at a national level is a useful basis for answering these key questions, which include:

1. What biodiversity does a country have and where is it?
2. What is the state of biodiversity across the landscape and seascape?
3. Where and how should a country act first to manage and conserve biodiversity?

Recent analysis has shown that the majority of countries have included very little spatial data in their updated National Biodiversity Strategies and Action Plans (NBSAPs). This is in spite of increasing requirements from the Convention on Biological Diversity to do so, in recognition of the benefits that such information can have for effective policymaking and implementation. For example, spatial biodiversity assessment at a national level can help to monitor the state of biodiversity and identify geographic priority areas and actions to address urgent conservation needs.

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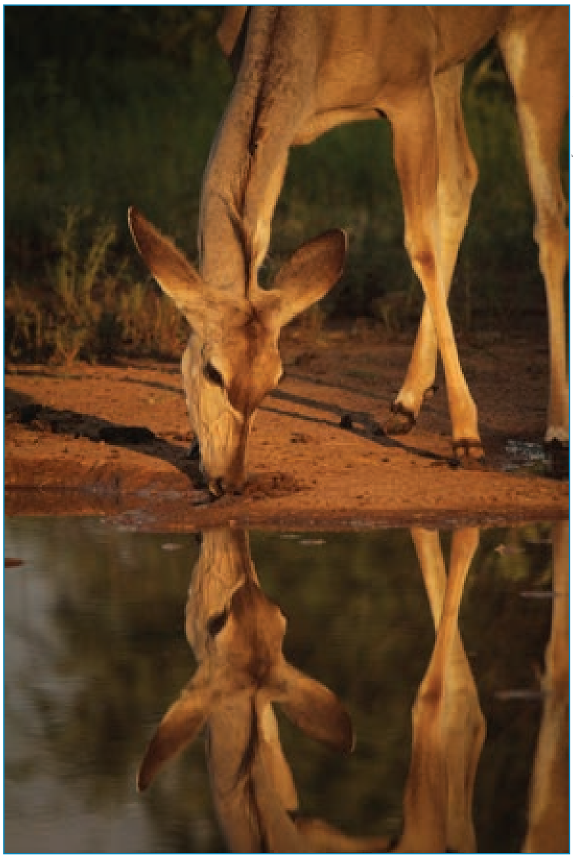
This document sets out a practical, science-based approach to spatial biodiversity assessment and prioritisation, which can be applied at the national level in any country. It is especially useful for countries that are both biodiversity rich and resource constrained, where difficult choices have to be made about how and where to focus conservation action. This document shows how even the most data-poor country can use available global data as the basis for an initial spatial assessment and prioritisation that will yield useful results. The core intended audience is those individuals involved in revising or implementing NBSAPs, although the approach has many other wider applications.

The approach presented here draws on the principles of systematic conservation planning to conduct a simple, country-wide biodiversity assessment and prioritisation. Only four basic datasets are required to use the approach. These are (1) a map of ecosystem types, (2) a map of ecological condition, (3) a map of protected areas and (4) a set of biodiversity targets for ecosystem types. In most cases, these can be relatively easily generated, or sourced from global datasets. Combining these datasets in a few simple analyses will allow a basic biodiversity assessment and prioritisation to be carried out. The assessment process produces two easily understood and relevant headline indicators of the state of biodiversity: ecosystem threat status and ecosystem protection level, which can be monitored over time. Prioritisation produces a set of biodiversity priority areas that should be the focus of conservation action.

The products of this approach can feed easily into national biodiversity strategy and action planning. They include maps that can be used by a broad range of stakeholders and provide a wealth of information about where important biodiversity occurs, where it is most threatened and where to act first. In addition to a wide range of other policy applications, countries that follow this approach will be better placed to produce more effective NBSAPs based on informative spatial data.



1. Introduction

This document sets out a practical, *science-based approach*[G] to spatial biodiversity assessment and planning, which can be applied at the national level in any country[2]. It is especially useful for countries that are both biodiversity-rich and resource-constrained, where difficult choices have to be made about how and where to focus conservation action. However, the approach is also useful in less biodiverse settings and where resources are more plentiful, and can also be applicable at sub-national and regional levels.

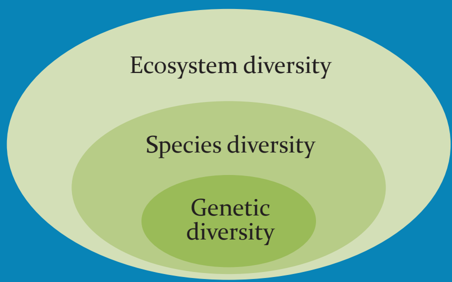
In almost any context, **three key questions** are useful for informing conservation policy and action:

1. What *biodiversity*[G] does a country have and where is it?
2. What is the state of biodiversity across the landscape and seascape?
3. Where and how should a country act first to manage and conserve biodiversity?

Spatial biodiversity assessment and prioritisation at a national level can answer these questions in a way that is useful for a range of different applications, including, for example, biodiversity monitoring, state of the environment reporting and protected area expansion, as well as the integration of biodiversity objectives into the operations of other sectors. For this reason, the Convention on Biological Diversity (CBD) is increasingly framing its goals and targets in *spatial*[G] or geographic terms.

What is biodiversity?

Biodiversity includes the diversity of genes, species and ecosystems on Earth, and the ecological and evolutionary processes that maintain this diversity.



[2]Terms that appear in the Glossary at the end of this document are indicated with a superscript "G" the first time they are used in the text.

National Biodiversity Strategies and Action Plans (NBSAPs)[G] are the principal instruments for implementing the CBD at the national level. The CBD requires countries to prepare national biodiversity strategies (or equivalent instruments) and to ensure that these are taken up into the planning and activities of all sectors whose actions can have an impact (positive and negative) on biodiversity (https://www.cbd.int/nbsap/). At the 10th meeting of the Conference of the Parties to the CBD (COP 10), parties were urged to use their revised and updated NBSAPs as effective instruments for the integration of biodiversity targets into spatial planning processes by governments and the private sector at all levels (decision X/2). Spatial data and mapping can provide benefits within an NBSAP to illustrate the current state of biodiversity in a country, identify national priorities, and visually communicate key biodiversity issues. These data can provide baselines to track progress towards national and international targets, analyse trade-offs, measure policy impacts, and consider future scenarios.

The core intended audience for this document is people who are involved in the process of updating, revising, or implementing NBSAPs, or others involved or interested in the NBSAP process. However, the document has broader relevance to anyone operating in a land, catchment or ocean management or spatial planning role, including conservation planners, protected area managers, researchers at universities or organisations, and others involved in spatial planning in any context. The audience also includes policy- and decision-makers who require an information resource to aid understanding in this subject area. To reach this broad audience, the document provides an overview of the approach through simple flow charts, and aims to provide sufficient technical detail in tables to assist readers who wish to implement the approach.

1.1 BENEFITS OF A SYSTEMATIC, SPATIAL APPROACH

Since biodiversity is not distributed evenly across the landscape or seascape, and neither are the pressures that act on it, it is important to have a defensible and spatially explicit approach, based on the best available science, to assess the state of biodiversity and decide on priority areas for action. This is especially the case in mega-diverse countries that have many different ecosystems and species in need of conservation, and in those countries with limited resources that must be focused on the most urgent priorities. The approach is also beneficial in many other circumstances including data rich, well-resourced settings. Three key advantages of a systematic, spatial approach are discussed below.

All aspects of biodiversity are comprehensively included. Existing conservation efforts are often biased towards charismatic species, regions that happen to be well sampled, or the objectives of particular organisations. In contrast, the approach presented here aims to reduce such biases by using a systematic methodology that includes all terrestrial, inland water, coastal and marine ecosystems and species. Each ecosystem or species is treated objectively, and is not given undue preference based on skewed or subjective information. Including ecosystem-level surrogates across the entire landscape or seascape gives even un-described species a high probability of being conserved. The approach also includes a specific focus on safeguarding *ecological processes*[G] at a range of spatial scales that are required for continued functioning and persistence of biodiversity over time and for the supply of *ecosystem services*[G] to people. Since comprehensiveness and objectivity are explicit goals, the results are both verifiable and defensible.

Methods are pragmatic, flexible and can be applied widely. The methods described here are flexible enough to be achievable even when data and resources are limited. The basic procedure can be applied relatively simply and quickly when necessary, but can also be used as a basis for ongoing improvement and refinement that will yield increasingly sophisticated outputs. It can be conducted at a broad spatial scale to

determine national priorities, but also at finer scales for other applications, such as informing land-use planning at the local level. The methods are similar, and results of the analyses are comparable, across the terrestrial, inland water, coastal and marine realms.

Outputs support a range of sustainable development applications. This approach can inform many different kinds of planning and decision-making in support of sustainable development. It implicitly considers conservation as part of a range of appropriate land uses and seeks to avoid conflict between the conservation sector and other sectors, such as agriculture, forestry, mining, tourism, and urban and regional planning. One of the useful outputs is a simple set of indicators of the state of biodiversity that are easily understandable by a wide audience. These can be used for monitoring and reporting at a national level, and to make recommendations to restrict certain land uses in the most threatened areas. Similarly, maps of priority areas can be easily linked to explicit conservation actions, such as the expansion of *protected areas*[G]. The ease of application means that outputs of this approach have the potential for significant uptake and wide-ranging impacts.

1.2 PURPOSE AND STRUCTURE OF THIS DOCUMENT

Many countries may feel that, while a spatial biodiversity assessment would be valuable, it is largely out of reach due to limited biodiversity data and resources. However, it is possible to use available spatial data to conduct a national assessment of biodiversity in a short space of time and with modest resources. Even a coarse-scale initial biodiversity assessment can be a highly useful informant for an NBSAP.

This document sets out a simple, science-based approach to conducting a national biodiversity assessment and prioritisation using a small number of key datasets. The approach is based on the well-known principles of *systematic conservation planning*[G], as well as several additional operational principles developed through practical application of the approach. The ten most important principles to keep in mind when applying the approach are discussed in **Section 3: Guiding principles**. The small number of key datasets that form the basis for the approach are discussed in **Section 4: Datasets**.

The approach distinguishes between biodiversity assessment and prioritisation in the following way:

Assessment[G] addresses the question of the state of biodiversity within a country (key question 2, above). **Section 5: Assessment** shows how, by combining key datasets, and with limited additional analysis, it is possible to achieve an assessment of two headline indicators of the state of biodiversity. These indicators highlight the *ecosystem types*[G] that are most threatened and those that are poorly represented in the protected area network.

Prioritisation[G] takes this information one-step further, by analysing the opportunities and limitations at sites that are important for meeting *biodiversity targets*[G]. Prioritisation helps to answer the question of where to focus conservation efforts (key question 3, above), by highlighting spatial priority areas for conservation action. **Section 6: Prioritisation** shows how to use some additional data and simple systematic conservation planning methods to identify an efficient set of national *biodiversity priority areas*[G] that will inform where it is most effective to act first.

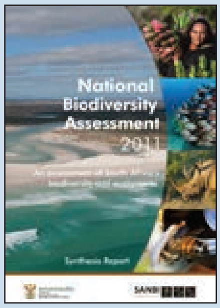
By following the steps set out in these sections, it will be possible to develop some valuable products, as discussed in **Section 7: Products**. These are typically in the form of maps and accompanying guidelines, which can inform strategy and action planning in the biodiversity sector, as well as planning and decision making in a range of other sectors than impact on biodiversity. In **Section 8: Enabling factors** some institutional and other factors are discussed that will make the approach easier to conduct and implement.

Examples from South Africa: South African examples are given at several points in the document to highlight key methods or outputs. South Africa has developed and extensively applied the methods described in this document over the past 15 years, and has accumulated practical experience of both the challenges that can be experienced as well as the ultimate versatility and value of the approach.

Case studies: A selection of case studies are included that showcase other regions where similar methods have been successfully applied, within both the terrestrial and marine realms, to assess the state of biodiversity and prioritise conservation action. These case studies highlight the value of this approach in a range of situations.

Box 1: Example from South Africa: Developing the approach

The National Spatial Biodiversity Assessment (NSBA)[3], completed in 2004, represented the first attempt in South Africa at a national, spatial assessment of biodiversity. It was the first comprehensive assessment of the state of biodiversity in the country, spanning terrestrial, inland water, coastal and marine realms. The NSBA was conducted in less than a year, with very limited resources and only a small team of people. It used what data were available at the time, building on some excellent research, but also highlighting extensive data gaps. Nevertheless, it became one of the most widely used resources in the conservation sector in South Africa, informing the development of the first South African NBSAP, and prompting a range of important conservation actions. The NSBA was also valuable in helping users understand the concept and outputs of other conservation plans.



The NSBA has since become a core aspect of national biodiversity strategy in South Africa, and it has been institutionalised as an ongoing responsibility of the South African National Biodiversity Institute (SANBI). The most recent revision, the National Biodiversity Assessment 2011 (NBA 2011)[4], made significant progress in filling data gaps and refining the methodology. It continues to highlight conservation priorities in South Africa and guide biodiversity strategy for the country, including the recent revision of the South African NBSAP. The next National Biodiversity Assessment is due to be completed in 2018.

[3] Driver, A., Maze, K. Rouget, M., Lombard, A.T., Nel, J., Turpie, J.K., Cowling, R.M., Desmet, P., Goodman, P., Harris, J., Jonas, Z., Reyers, B., Sink, K. & Strauss, T. 2005. National Spatial Biodiversity Assessment 2004: priorities for biodiversity conservation in South Africa. Strelitzia 17. South African National Biodiversity Institute, Pretoria.

[4] Driver A., Sink, K.J., Nel, J.N., Holness, S., Van Niekerk, L., Daniels, F., Jonas, Z., Majiedt, P.A., Harris, L. & Maze, K. 2012. National Biodiversity Assessment 2011: An assessment of South Africa's biodiversity and ecosystems. Synthesis Report. South African National Biodiversity Institute and Department of Environmental Affairs, Pretoria.

2. Key questions

Regardless of the policy context or circumstances of a country, there are certain fundamental questions that, if answered, will provide a wealth of information for biodiversity strategy and action planning. Even greater value will be obtained by asking and answering these questions in a spatially explicit way. By doing so, conservation actions can be focussed on specific biodiversity priority areas, making the best use of limited resources and avoiding conflicts with other sectors in many cases. Almost any policy-relevant question about a country's biodiversity will be related to one of these key questions, and the approach presented here provides a way to answer them simply and effectively.

In this section, the three key questions are expanded to give examples of the sub-questions that may be explored within each one.

Key question 1: What biodiversity does a country have and where is it?

- What different types of ecosystems exist in the country and where are they found?
- What species of special concern occur in the country and where are they found?
  - Where are known threatened species, based on Red Lists?
  - Where are nationally or locally endemic (or near-endemic) species?
  - Where are culturally, socially or ecologically important species (e.g. flagship species, keystone species or species utilised by people)?
- Which ecological processes are important and where do they occur?
  - What ecological processes are important for the persistence of ecosystems and species, and where do they occur?
  - What natural areas or sites play an *ecological infrastructure*[G] role, by generating or delivering valuable services to people?

Key question 2: What is the state of biodiversity across the landscape and seascape?

- How much of each ecosystem type, species or ecological process should remain in a natural or near-natural state to ensure persistence of biodiversity into the future?
- How much biodiversity is left and is that enough to meet biodiversity targets?
  - Where are key pressures on biodiversity being experienced? (e.g. land cover change, overharvesting, water abstraction, invasive alien species)
  - What is the ecological condition of the remaining biodiversity?
  - Is biodiversity sufficiently functional and connected to allow persistence into the future?
- How much of each ecosystem type and species is protected and is that enough?
  - Where are existing protected areas and do they include sufficient examples of all aspects of biodiversity?
- How is the state of biodiversity changing over time?

Key question 3: Where and how should a country act first to manage and conserve biodiversity?

- Which geographic areas are most important for conserving and managing biodiversity through a range of appropriate interventions?
  - Where should efforts for limiting loss of natural habitat by a range of sectors be focused (e.g. through ensuring that these sites are taken into account in land-use planning)?
  - Where should protected areas be established or expanded?
  - Where should efforts for rehabilitation of degraded ecosystems be focused? (e.g. through the removal of invasive alien species or rehabilitation of wetlands)
- Which sites need most urgent intervention?
- Where can scarce resources be used most efficiently to get the best response?
- How can biodiversity targets be met while avoiding unnecessary conflict with other sectors?
- What other interventions are important for supporting place-based actions? (e.g. policy, regulatory, social, research)

3. Guiding principles

In this section, ten guiding principles are discussed, which should be kept in mind during any spatial biodiversity assessment or prioritisation. Some are conceptual, and others relate to the process of undertaking assessment or prioritisation. Adhering to them is likely to improve the ease of conducting a national biodiversity assessment and prioritisation, and to enhance the utility of the outputs.

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The **first three principles** follow the well-known principles of systematic conservation planning[5]. The **next seven** are additional principles that have been distilled from experience of applying this approach.

1. **Aim to conserve a viable representative sample of every different type of biodiversity**. *Representation*[G] is one of the two main goals of systematic conservation planning and is a fundamental basis for the approach described here. The purpose of representation is to conserve a sufficient sample of all species and all ecosystem types. It recognises that there has often been a historical bias in conservation action that has either favoured charismatic species for conservation or placed protected areas only in those areas not wanted for other purposes. By aiming for full representation of all ecosystem types and species, the unique attributes, potential uses and intrinsic value of all biodiversity native to a country will be conserved.

2. **Aim to conserve key processes that allow biodiversity to persist over the long term**. *Persistence*[G] is the second of two main goals of systematic conservation planning. It refers to the need to maintain ecological and evolutionary processes that enable ecosystems and species to persist over time. Consideration must be given to the quantity and configuration of biodiversity priority areas that will be needed to maintain ecosystem functioning in the long term. Addressing persistence may include making provision for ecological corridors that allow movement of species and enable connectivity in the landscape, or considering how adaptation to climate change could be facilitated, amongst other factors. By planning for persistence, conservation actions taken today will still have relevant benefits well into the future.

3. **Set quantitative biodiversity targets to achieve representation and persistence**. Biodiversity targets are quantitative measures used both to identify conservation priorities (through planning) as well as to evaluate the success or impact of conservation actions (through monitoring). Biodiversity targets refer to the amount of biodiversity that should be kept in a *natural* or *near-natural*[G] state in order to meet the goals of representation and persistence. Deciding how much biodiversity is needed to meet conservation goals is not simply a technical step, but is fundamental to many aspects of assessment and prioritisation. Biodiversity targets should be quantitative and based on the best available science to ensure that they are defensible, but more importantly, to provide assurance that by achieving the targets, the desired conservation outcomes of representation and persistence will likewise be achieved. **Section 4.4: Biodiversity targets** contains more information.

4. **Use the best available science to ensure robust, defensible and credible results**. Throughout this approach, the best available data should be used, and any limitations of the data carefully considered before it is included. Expert knowledge can be included where appropriate, and often plays a vital role at various stages in the process. It is important to check that any step taken makes ecological sense, rather than just following a set methodology. Each step should be carefully documented, including the data used, methods applied, and any assumptions made during the process, and this information should be made available in a technical document that accompanies the other outputs. This will allow the scientific community to understand, and potentially repeat, the methods. The primary reason for emphasising a scientifically sound process is to make certain that the results are credible, defensible, and repeatable. With a scientific basis, the biodiversity assessment and prioritisation will be better able to stand up to any criticism or queries.

[5]Margules & Pressey. 2000. Systematic conservation planning. Nature 405, 243-253. http://www.nature.com/nature/journal/v405/n6783/full/405243a0.html

5. **Aim for consistency across terrestrial, inland water, coastal and marine realms**. The approach described here is equally applicable across a wide range of ecosystems in different environments. The aim should be to keep the broad approach as similar as possible, so that the results are generally equivalent and comparable, while allowing for some flexibility to deal with different types of data and different contexts. This allows for planning and decision-making to be inclusive and properly aligned between the terrestrial, inland water, coastal and marine realms. Ultimately, it may be possible to achieve a single integrated set of products that incorporates information across the terrestrial, inland water, coastal and marine realms, but a separate broadly consistent assessment or prioritisation for each realm can also be extremely useful.

6. **Use an adaptive approach: start simply and plan for iterative improvements**. The first time that this approach is applied in a country may well be simple and basic due to data or capacity constraints. It is very useful to start simply, rather than awaiting optimal data and capacity to conduct a more sophisticated assessment at some future date. The first simple assessment or prioritisation is likely to be a very valuable starting point, and can be built on in subsequent iterations as more data become available. Indeed, an initial assessment or prioritisation often helps to point to key data gaps, and to provide the impetus to fill them. It is necessary to be conscious of not revising the outputs too often or unnecessarily, especially if they are used to inform policy- and decision-making, as this can cause confusion or mistrust among users. It is thus important to balance stability of the outputs with iterative improvement, and to ensure there is clear communication about which is the most appropriate version to use.

7. **Keep the process simple, with clear and understandable outputs**. Biodiversity is complex, with many facets, ranging from genes to landscape-scale ecological processes. However, allowing assessment or prioritisation to become overly complex does not enhance its utility or application. While remaining aware of the underlying complexity, it is important to aim to keep the assessment and prioritisation process, and more particularly the outputs, as simple as possible. This can be achieved by summarising results in a few headline indicators and a few simple maps, linked to clear messages, which will allow the products to be used most widely.

8. **Make a clear link to implementation by remaining aware of the policy context**. The implementation context, needs, and opportunities should be considered throughout the process of assessment and prioritisation, from conceptualisation to dissemination of the final products. Requirements for implementation may tailor the questions that are asked, the data and methods used, and the type or structure of products that are produced. For this reason, it is important for those involved in the assessment or prioritisation process to be familiar with the implementation context and to understand how, and by whom, the products will be used, in order to ensure that they are fit for the purpose of implementation.

9. **Be appropriately inclusive and engage stakeholders at relevant stages**. Gaining stakeholder endorsement of the assessment and prioritisation process and products is essential for the uptake of the results. As with any process that aims to involve stakeholders, it is beneficial to be inclusive from an early stage. However, it must also be understood that certain aspects of assessment and prioritisation are more appropriate to certain stakeholder groups, and not all stakeholders need to be involved in every aspect throughout the entire process. For assessment, it may be appropriate to involve only a smaller group of core stakeholders, while for prioritisation, broader stakeholder involvement usually becomes more important. Stakeholder involvement should be strategic and well-structured to avoid unproductive interactions that might simply result in stakeholder fatigue. Hence, the science community, practitioners, policymakers, and broader stakeholders should be included at the most appropriate times, and not necessarily all at the same time.

10. **Make the products easily accessible for wide use**. Products of this approach are likely to include: input data layers (which are often useful products in their own right), map products (the outputs of the analysis) and other accompanying products (such as technical reports, lists, guidelines and implementation guides). All of these products should be made freely available from a well-known, credible and easily accessible online source. For scientific audiences, the information that should be made available includes input data and technical documentation on the scientific methods used. For potential users of the data, the products and outputs should be provided in suitable formats that are easily accessible, to improve use and uptake. There are limited exceptions where data privacy may be important, such as for data on threatened species targeted by collectors.

4. Datasets

Four key datasets are required to complete a basic spatial biodiversity assessment and prioritisation process at a national level (Table 1). These are not only important building blocks of the approach presented here, but are also useful products in their own right. They provide a wealth of information about what biodiversity is present within a country, its location and the major pressures that it faces.

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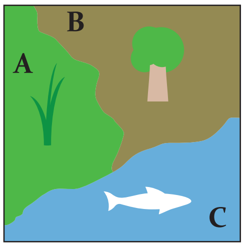
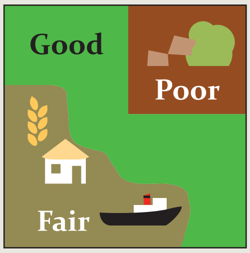
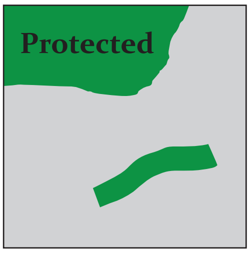
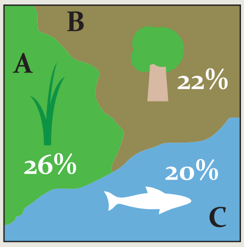
Table 1: The four key datasets required for a spatial assessment or prioritisation of biodiversity.

	**Map of ecosystem types** Ecosystem types are spatial units that are likely to share broadly similar ecological characteristics and functioning. This map is used as a surrogate for a range of biodiversity features. It should cover the entire area of the country that is being assessed and show the historical extent of each ecosystem type, including areas where natural habitat has subsequently been modified or lost.
	**Map of ecological condition** A map of ecological condition shows the current condition of the landscape or seascape. It is useful to categorise ecological condition into a few categories based on the degree of modification from natural. Natural or near-natural areas are considered to be in good ecological condition, semi-natural or moderately modified areas to be in fair ecological condition, and severely or irreversibly modified areas to be in poor ecological condition.
	**Map of protected areas** Protected areas are areas of land or sea that are formally protected by legal or other effective means, and managed mainly for biodiversity conservation. The map of protected areas shows the location and boundaries of existing protected areas.
	**Biodiversity targets** Biodiversity targets are the minimum proportion of each ecosystem type that needs to be kept in a natural or near-natural state (i.e. in good ecological condition) to conserve a viable representative sample of biodiversity over the long term. Biodiversity targets are set in relation to the historical extent of each ecosystem type, using best available science.

The sections below examine the important characteristics of each of these key datasets, and provide guidance on how to source or generate them for a region or country. While these four key datasets may not be immediately accessible to a data-poor country, in most cases it will be possible to modify and stratify available global datasets to provide data of sufficient quality for an initial, basic assessment and prioritisation. While it is always better to use national datasets, if these are not available then global datasets provide an opportunity to perform a preliminary assessment in countries or regions where no other data exists, which is preferable to having no spatial biodiversity information to inform conservation strategy and planning. An initial assessment and prioritisation using available global data can help to identify data gaps and plan for improvements in data quality over time, while still providing insight that can usefully inform conservation strategy in the meantime.

4.1 MAP OF ECOSYSTEM TYPES

The primary biodiversity input for the analysis is a map of ecosystem types, which is used as a surrogate for a range of other *biodiversity features*[G]. Ecosystem types are spatial units that are likely to share broadly similar ecological characteristics and functioning. Using ecosystem types is a precautionary approach in situations where other biodiversity data may be limited or geographically biased. Ecosystem types serve as a proxy for biodiversity that would otherwise be excluded from the analysis, such as unknown species, species for which there is poor data availability and even some local-scale ecological processes.

There are certain characteristics that are important in developing any map of ecosystem types:

Complete coverage of the country or region. The map of ecosystem types should cover the entire region or country being assessed. Complete coverage will mean that biodiversity is fairly represented across the country or region and no part of the land- or seascape is excluded from the analysis. Complete coverage can highlight pressures on overlooked areas that have not been the focus of previous research or conservation efforts. Complete coverage is also necessary for making meaningful comparisons, such as countrywide proportions of threat status and protection level.

A pragmatic approach to ecosystem types

Ecosystem types evolve and change over time, for example, in response to climate change. Such ecosystem changes typically happen over much longer time scales than does planning. While acknowledging ecosystem change, mapping and classifying ecosystem types is a pragmatic way of assessing, managing and monitoring the state of biodiversity in a country. The dynamic nature of ecosystems can be taken into account by including aspects of ecological processes and climate change in prioritisation, to maximise the ability of ecosystem types to evolve and adapt.

Map the historical extent of the ecosystem types. It is necessary to know the historical extent of ecosystems to assess their current status and understand the extent to which they have undergone loss. Establishing a historical baseline for the extent of an ecosystem type provides a stable measure against which to assess the degree of loss. Preferably, the historical extent should be mapped to a pre-industrial baseline, before large-scale human modification of the landscape occurred. This is understandably difficult in some regions, where a decision will have to be made about an appropriate baseline. Accurate spatial delineation of historical boundaries of ecosystem types is not always possible or even required, and it may be sufficient to use broad-scale mapping combined with expert judgement to estimate the extent to which some ecosystem types have been lost or modified.

Use ecologically meaningful units. Meaningful ecological units make it easier to interpret the results and incorporate them into conservation policy, strategy and action. Ideally, the map of ecosystem types should be supported by ground-truthed data on species composition where available. However, if this is not available, a pragmatic initial map of ecosystem types can be constructed from remotely sensed data or biophysical data layers that are usually widely available (Table 2).

Improve integration across different realms. Ideally, the map of ecosystem types should be continuous across the terrestrial, inland water, coastal and marine realms. This enables integrated prioritisation across realms and all-in-one map products, and allows better incorporation of the specialised ecosystems that form the boundary between realms. Exchanges that occur across boundaries such as the land-sea boundary (coastline) are ecologically important and should not be disregarded during assessment and prioritisation. However, given the different data sources in each of the realms, such integration is not always achievable. In such cases, it is still extremely useful to create a separate map of ecosystem types for each realm, with the aim of improving alignment and edge-matching over time so that ultimately they can be integrated into a single map.

Establish a sensible classification with a nested hierarchy. Local ecosystem types should be nested within broader categories. If no other data are available, start with a broad-scale biome-level or ecoregion-level map, and work towards refining the lower levels of the hierarchy over time. Fully nested hierarchies enhance the utility of the map of ecosystem types, making it more appropriate as a basis for assessment and prioritisation at a range of spatial scales. A national map and classification of ecosystem types that becomes well-established is an extremely valuable product in its own right that is likely to have a wide range of applications.

Sourcing or developing a map of ecosystem types is slightly different across the terrestrial, inland water, coastal and marine realms (Table 2). Several broad-scale global datasets are available that can often be used in the absence of more accurate national data, or it may be possible to generate a map of ecosystem types from available biophysical data. Even data-poor countries will be able to generate a useful initial version with little need for additional data collection.

Table 2: Sourcing or generating a map of ecosystem types across the terrestrial, inland water, coastal and marine realms.

Terrestrial	• In the terrestrial environment, vegetation types provide an excellent way of delineating ecosystems at a relatively fine scale. • National vegetation maps are available for many countries as a result of botanical research. • In the absence of a vegetation map, a basic terrestrial map of ecosystem types can be generated using a combination of biophysical data layers such as soil types, elevation, geology, and rainfall. • Expert or local knowledge can be used to assist in the classification and delineation of ecosystem types, for example by refining existing data.
	Global data available: • USGS Global Ecological Land Units: http://rmgsc.cr.usgs.gov/ecosystems/docs/AAG_Global_Ecosystems_Booklet.pdf • USGS terrestrial ecosystems of Africa and South America: http://rmgsc.cr.usgs.gov/ecosystems/index.shtml • WWF Terrestrial Ecoregions Of the World (TEOW)
Inland water	• Basic datasets for developing a map of inland water ecosystem types include maps of the river network and wetlands for a region or country. It is also useful to have a map of catchments. • Many countries have a map of their river network, at least of major rivers at a broad scale. • Maps of larger wetlands can often be extracted from a topographical map and/or land cover data, if a national map of wetlands does not exist. • Where possible, inland water ecosystem types can be categorised using hydrological, geomorphological, or biological characteristics. • Finer scale classification can be achieved by including additional information such as flow variability, channel gradient, and species composition. • Expert or local knowledge can be used to assist in the classification and delineation of inland water ecosystem types, for example by refining existing data.
	Global data available: • HydroSheds: http://www.worldwildlife.org/pages/hydrosheds (includes river networks and watershed boundaries) • Freshwater Ecoregions of the World: http://www.feow.org
Coastal and marine	• Maps of marine ecosystem types can be created from a small set of globally available biophysical layers, including sediment and depth. • At the broadest level, marine and coastal environments can be divided into coastal, inshore, and offshore. • Depth classes (coastal, inshore, shelf, shelf edge, upper bathyal, lower bathyal, and abyss) can be used as a basis for further delineating marine ecosystem types. • Additional factors used to classify coastal or marine ecosystem types can include substrate (e.g. rocky shore or sandy beach), geology, wave exposure, or biogeography. • It is also possible to map some coastal ecosystems from remote sensing imagery. • Expert or local knowledge can be used to assist in the classification and delineation of coastal and marine ecosystem types, for example by refining existing data.
	Global data available: • General Bathymetric Chart of the Oceans: http://www.gebco.net/ • Marine Ecoregions of the World: http://www.worldwildlife.org/publications/marine-ecoregions-of-the-world-a-bioregionalization-of-coastal-and-shelf-areas • USGS & ESRI Global Ecological Marine Units

4.2 MAP OF ECOLOGICAL CONDITION

The map of *ecological condition*[G] defines the degree of modification of the landscape or seascape, varying from areas that remain in a natural or near-natural condition, to those that are severely or irreversibly modified. The purpose of the map of ecological condition is to determine the amount and location of natural habitat that remains available for achieving biodiversity targets. Maps of ecological condition combine information on the impact of different drivers of ecosystem change (such as land cover change, alteration of freshwater flows, overharvesting of resources, invasive alien species or climate change) into a single map. Thus, mapping ecological condition is a way of summarising the many pressures acting on ecosystems, since an ecosystem with many severe pressures is likely to be in poor ecological condition. Similar to the use of ecosystem types as a surrogate for biodiversity, ecological condition is a surrogate for a range of human pressures on the natural environment.

There are many appropriate ways to map ecological condition, and methods often differ across the terrestrial, inland water, coastal and marine realms (Table 3). Ideally, more detail about ecological condition is better, so including several categories that show degrees of modification from natural is helpful. At least three categories (such as good, fair, poor) is preferable. However, it is sometimes difficult to distinguish between fair and good ecological condition, and it may be possible to distinguish only between areas that are broadly intact and those that have been severely or irreversibly modified, effectively reducing the condition assessment to two categories. A simple map of condition using two categories is sufficient for an initial assessment and prioritisation. Whichever method is chosen, the aim should be simple classification of ecological condition into sensible and easily understood categories.

Table 3: Sourcing or generating a map of ecological condition across the terrestrial, inland water, coastal and marine realms.

Terrestrial	• The primary source of data for the map of ecological condition in the terrestrial environment is land cover. • Land cover classes can in many cases be linked to degree of modification and thus to ecological condition. • It may be possible to use a range of additional data sources to supplement land cover data (e.g. road data, aerial imagery, lights at night). • Additional data on specific sectors may be useful (e.g. data on the location of agricultural fields, plantation forestry, and extractive industries are sometimes available).
	Global data available: • GlobCover (http://due.esrin.esa.int/page_globcover.php) • CCI Land Cover (http://www.esa-landcover-cci.org/?q=node/158) • GlobLand-30 (http://www.globallandcover.com/home/Enbackground.aspx)
Inland water	• Ideally, an assessment of the ecological condition of rivers requires data on a range of factors such as modifications to hydrology (the quantity, timing and velocity of flow in the river), water quality, in-stream habitat and riparian habitat. • If such information is not available, the ecological condition of rivers can be assessed by using land cover data to estimate the proportion of natural vegetation in the river catchment and within a defined buffer along the river corridor. The higher the proportion of natural vegetation, the better the ecological condition of the river is likely to be. • Wetland condition can be assessed by using land cover data to estimate the proportion of natural vegetation in, and surrounding, the wetland. • Other proxies for pressures on inland water ecosystems can be included where available, for example dams or road crossings, which fragment inland water ecosystems. • The assessment of ecological condition of rivers and wetlands should be supplemented with site-level data or expert knowledge whenever available.
Coastal and marine	• There is no equivalent to land cover in the marine environment, but data on pressures on marine ecosystems can be used as a proxy for ecological condition. • Pressures in the marine environment can include fishing, mining, shipping, waste water discharge, coastal development, mariculture, and invasive species, amongst others. • Information on these pressures is sometimes available from the relevant industries or government departments. • These pressures need to be sensibly converted into a map of ecological condition, for example, by applying a matrix that scores the impact of each pressure within each ecosystem type.
	Global data available: • Ben Halpern Research Group: http://benhalpernlab.org/products-2/ • Ocean Data Viewer[6]: http://data.unep-wcmc.org/

[6]Whilst the Ocean Data Viewer contains maps of biodiversity, they are generally of poor resolution and as such, caution should be applied if using them to infer ecological condition. At present it is considered that this type of data is not yet globally available for the marine realm.

4.3 MAP OF PROTECTED AREAS

Protected areas are areas of land or sea that are formally protected by legal or other effective means, and are managed mainly for biodiversity conservation. The map of protected areas shows the location and boundaries of existing protected areas for the country or region. It is not always simple to obtain a complete map of protected areas for a country. Protected areas can be declared using a range of different legislation, such as environmental laws, forestry laws, marine regulations, and more, at both local and national levels of government, and often at different points in the history of the country. Nevertheless, most countries will be able to gather the necessary information on their own protected areas. For those that cannot, basic global data can be accessed from the World Database on Protected Areas (http://www.protectedplanet.net/).

Since protected areas may vary in the degree of formal protection and the degree of management effectiveness, some decisions must usually be made about whether certain protected areas can be considered as contributing towards meeting biodiversity targets in the analysis. In practice, management effectiveness is difficult to measure and there is often little information available about the management effectiveness of protected areas. The most pragmatic solution is to consider only those protected areas with secure, formal legal status as contributing to meeting biodiversity targets. A classification such as the IUCN Protected Areas Management Categories can also be used, for example by considering only categories I - III. In the marine environment, consideration should be given to the different zones that are often used in marine protected areas (for example, no-take zones and zones where extractive use of marine resources is permitted), as it may be necessary to treat these differently in the assessment process.

4.4 BIODIVERSITY TARGETS

Biodiversity targets are the minimum proportion of each ecosystem type that needs to be kept in a natural or near-natural state in the long term, in order to maintain viable representative samples of all ecosystem types and the majority of species associated with those ecosystem types. These targets help to answer the question "How much is enough to ensure the long-term persistence of biodiversity?" and are usually expressed as a proportion of the historical extent of each ecosystem type. Biodiversity targets are quantitative interpretations of conservation goals, and should be set at the start of the assessment.

There are valid methods for spatial prioritisation that do not require explicit biodiversity targets. However, biodiversity targets are useful as tangible, defensible goals against which to assess and monitor the state of biodiversity at a national level. The relevance of quantitative goals is recognised through the CBD Aichi Biodiversity Targets and the thresholds for the IUCN Red List of Ecosystems. For this reason, quantitative targets are recommended as central to the approach presented here and are a key factor in both spatial biodiversity assessment and prioritisation. During assessment, targets provide the threshold against which to evaluate the current situation. During prioritisation, targets provide the basis for identifying a portfolio of sites that meet the targets most efficiently and effectively.

Ideally, biodiversity targets should be based on the ecological characteristics for each ecosystem type, for example the area required to represent the majority of the species associated with that ecosystem type. However, scientific data are not always available to set such ecologically-based targets for each ecosystem type, especially in the inland water, coastal and marine realms (Table 4). In the absence of more detailed scientific knowledge, a flat target of 20% of each ecosystem type is pragmatic. This is in line with the IUCN Red List of Ecosystems, which assigns Critically Endangered status to ecosystems that have lost more than 80% of their geographic distribution over 50 years (http://iucnrle.org/).

It can be useful to distinguish between biodiversity targets and protected area targets. Biodiversity targets are the proportion of each ecosystem type that should remain in good ecological condition in perpetuity. Biodiversity targets should not change over time, unless they are refined by better science. Protected area targets are targets for the expansion of the protected area network, and are usually linked to a particular timeframe and updated periodically. A country may choose to set long-term protected area targets for its ecosystem types that are equivalent to their biodiversity targets, but may set short- to medium-term protected area targets that are less than the biodiversity targets.

Avoid the target trap

The setting of biodiversity targets is still a developing science in many contexts, and can become the basis for contentious and time-consuming debate amongst scientists. It is better to use a pragmatic approach (such as a flat target of 20% of each ecosystem type) than to wait for perfect science or consensus on ecologically-based targets. Flat targets can still provide useful results, and in practice, refining targets over time as the science improves does not usually dramatically affect the assessment or prioritisation outcomes.

Table 4: Basic methods for determining biodiversity targets for ecosystem types in the terrestrial, inland water, coastal and marine realms.

Basic methods for setting biodiversity targets	
	• Ideally, biodiversity targets should be set based on ecological characteristics, with higher targets for ecosystems with higher diversity or heterogeneity. • In both the terrestrial and marine realms, there are a number of proposed methods for determining targets based on ecological characteristics, including species-area curves, species occupancy models, extrapolated biodiversity samples, fisheries thresholds, or estimates of detection probability of species. • If insufficient data is available to develop targets based on ecological characteristics, a flat percentage target can be used, such as 20% of the historical extent of each ecosystem type. This is consistent with the approach used for the IUCN Red List of Ecosystems. • Flat percentage targets can also be combined with a minimum area, such as 20% of historical extent but not less than 10 000ha, or similar. • Another option is to use fixed percentage targets based on political goals, such as the 17% Aichi target. Such targets may sometimes be easier to justify to policymakers.

4.5 COMBINING THE DATASETS FOR ASSESSMENT AND PRIORITISATION

The four key datasets described above are all that is required to conduct a basic biodiversity assessment and prioritisation. By combining these datasets through a few simple analyses, it is possible to achieve a robust assessment of the state of biodiversity and an indication of the priority areas where action should be focused first (Figure 1).

Explanation of the methods for analysing these datasets, and details of the steps to be taken, are provided in **Section 5: Assessment** and **Section 6: Prioritisation** that follow.

✓ Ticks indicate which datasets are required for assessment and prioritisation		Assessment		Prioritisation	
		Ecosystem threat status	Ecosystem protection level	Priority areas for planning and decision making	Priority areas for protected area expansion
Four essential datasets	Map of ecosystem types	✓	✓	✓	✓
	Biodiversity targets	✓	✓	✓	✓
	Map of ecological condition	✓		✓	✓
	Map of protected areas		✓	✓	✓

Figure 1: Four key datasets can easily be combined to conduct a simple biodiversity assessment and prioritisation that can inform biodiversity strategy and action planning.

4.6 OTHER DATASETS

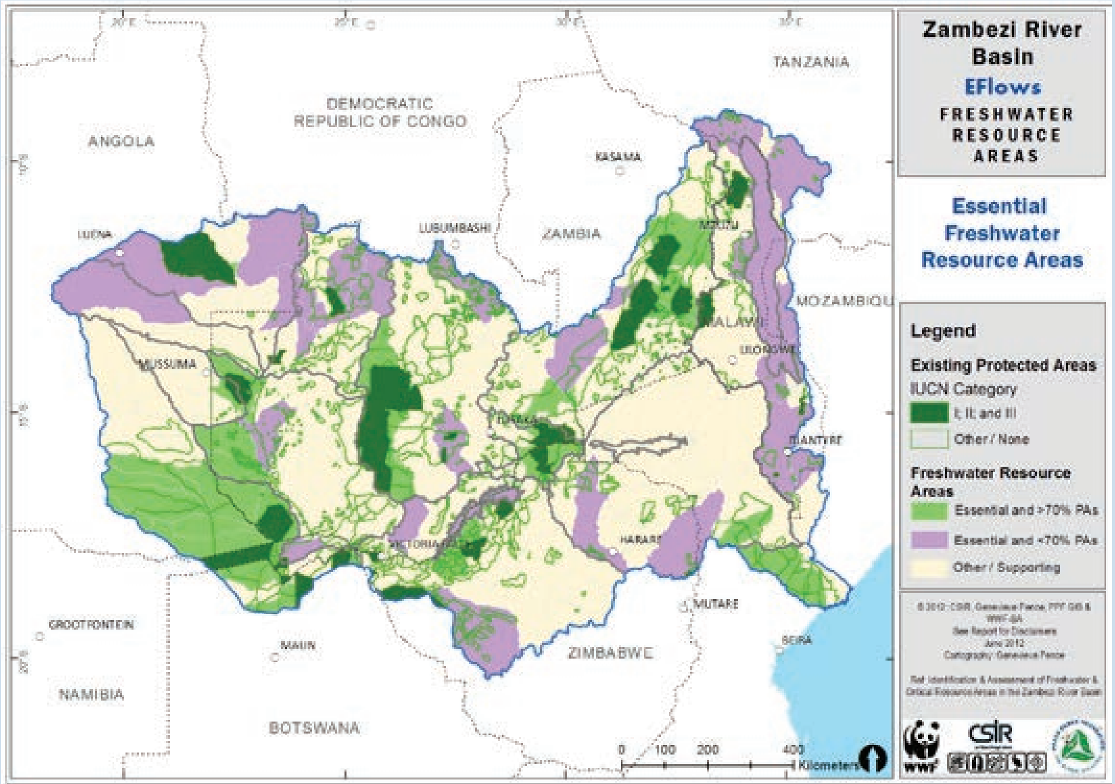
The above four datasets present the minimum requirements to conduct a national biodiversity assessment and prioritisation using the basic approach presented here. The focus on only a few key datasets, and the strong focus at the ecosystem level rather than the species level, is a deliberate effort to maintain the simplicity of the assessment approach, which is especially important for those countries that have limited additional data or resources.

A note of caution on species data

Species distribution data is often geographically biased towards areas of high sampling intensity (such as areas that are accessible to people). This will give a skewed representation of species presence and consequently bias the identification of priority areas towards those areas that have been well sampled. Species distribution data should thus be assessed carefully and used cautiously.

The key datasets, and the basic approach, form the foundation for a range of further analyses that can be performed once additional data becomes available. Particularly during prioritisation, incorporating a wide range of additional data can be extremely useful and can improve the prioritisation outputs. Additional data may include species distribution data, data on ecological processes, data on ecological infrastructure, and a range of socio-economic data. Citizen science initiatives are notably expanding the availability of species data, and innovative methods for mapping ecological processes are quickly developing. Including additional socio-economic, species and ecological data in a prioritisation will result in a more comprehensive and refined selection of priority areas. When available, these additional data should be included, always with due consideration for their possible limitations. Such additional spatial data may also have relevance for informing NBSAPs and other conservation strategy, even if it is not used directly in spatial biodiversity assessment or prioritisation.

Box 2: Case study: Additional data for prioritisation – the Zambezi Freshwater Resource Areas



Maps showing the areas important for delivering ecosystem services to people are one of the many additional types of data that can be included at the prioritisation stage. The Zambezi Freshwater Resource Areas[7] is an example of such a dataset, which identifies areas important for providing freshwater ecosystem services in the Zambezi basin.

The Zambezi River Basin covers nearly 2 million square kilometres, spans eight countries, and is important for supplying a wealth of ecosystem services that meet the most basic needs of approximately 30 million people. As part of a larger project conducted by the World Wide Fund for Nature (WWF), preliminary mapping was required to better understand the freshwater ecosystems in the basin. The aim was to map Freshwater Resource Areas within the basin, determine their importance for providing ecosystems services, and assess their current state.

Maps of freshwater ecosystems for the area were either sourced or generated from existing data: a watershed model was used to delineate 220 sub-catchments for the Zambezi basin, a rivers layer was derived from elevation data of the Shuttle Radar Topography Mission, and a wetlands layer was produced by merging five existing wetlands datasets. Large numbers of hydrological and physiographic characteristics were mapped to aid in the identification of Freshwater Resource Areas.

The Freshwater Resource Areas were then assessed based on their ability to supply hydrological services, their significance to local livelihoods, and their biodiversity value. The result is a map that shows a portfolio of Freshwater Resource Areas that are considered essential for meeting biodiversity targets in the Zambezi River Basin, and for sustaining key hydrological functions.

[7] Colvin, C., Pence, G., Maherry, A., Kahinda, J-M.M., Kapangaziwiri, E., Beech, C. & Faber, M. 2012. Zambezi Environmental Flows: Freshwater Resource Areas. Project number ZA1744, WWF-South Africa.

5. Assessment

Spatial biodiversity assessment evaluates the state of biodiversity across a country. It is centred on overlaying the key datasets to determine how ecosystem types, ecological condition and protected areas coincide spatially. This helps to give an indication of how much of each ecosystem type remains in good condition and how much is protected.

The biodiversity assessment evaluates the state of biodiversity based on two 'headline indicators', discussed in **Section 5.1: Headline indicators**. These indicators highlight which of the country's ecosystem types are most threatened, and which are in need of better protection. They are able to combine a range of information on biodiversity pattern, major pressures, and protected areas into a few easily understood categories. Assessments often present the only comprehensive analysis of the pressures on a country's biodiversity, with the ability to compare levels of threat between different ecosystem types and realms.

The products of a biodiversity assessment are usually a set of simple maps displaying the categories for each of the headline indicators, highlighting the location and configuration of the most threatened and under-protected ecosystems. The indicators can also be summarised on a simple bar graph and compared across realms. Ideally, maps should be accompanied by a user-friendly guideline document explaining what the maps and graphs show, and how they can be used. See **Section 7: Products** for more information on developing useful maps, graphs, and accompanying text. The relatively simple information achieved from a biodiversity assessment can inform a wide range of conservation policies and actions.

5.1 HEADLINE INDICATORS

The two headline indicators that result from the assessment process are based directly on the principles of representation and persistence (see **Section 3: Guiding principles**), and help to communicate information about these in a clear and intuitive way to a broad, non-technical audience. These headline indicators can be reported using interrelated graphics and maps that can quickly convey the primary results (see **Section 7: Products**). If the assessment is periodically revised using the same indicators, they can be used over time to monitor and report on the state of biodiversity at a national level. They can also feed into reporting on the state of the environment more broadly.

Ecosystem threat status[G] is an indicator of how threatened ecosystems are, or in other words, the degree to which ecosystems are still natural or near-natural, or are alternatively losing vital aspects of their structure, function, or composition. Assessing ecosystem threat status involves overlaying the map of ecosystem types with the map of ecological condition to determine the threat status of each ecosystem type (Figure 2). The proportion of each ecosystem type that remains in good condition is evaluated against a set of thresholds that include the biodiversity target, in order to determine its threat status.

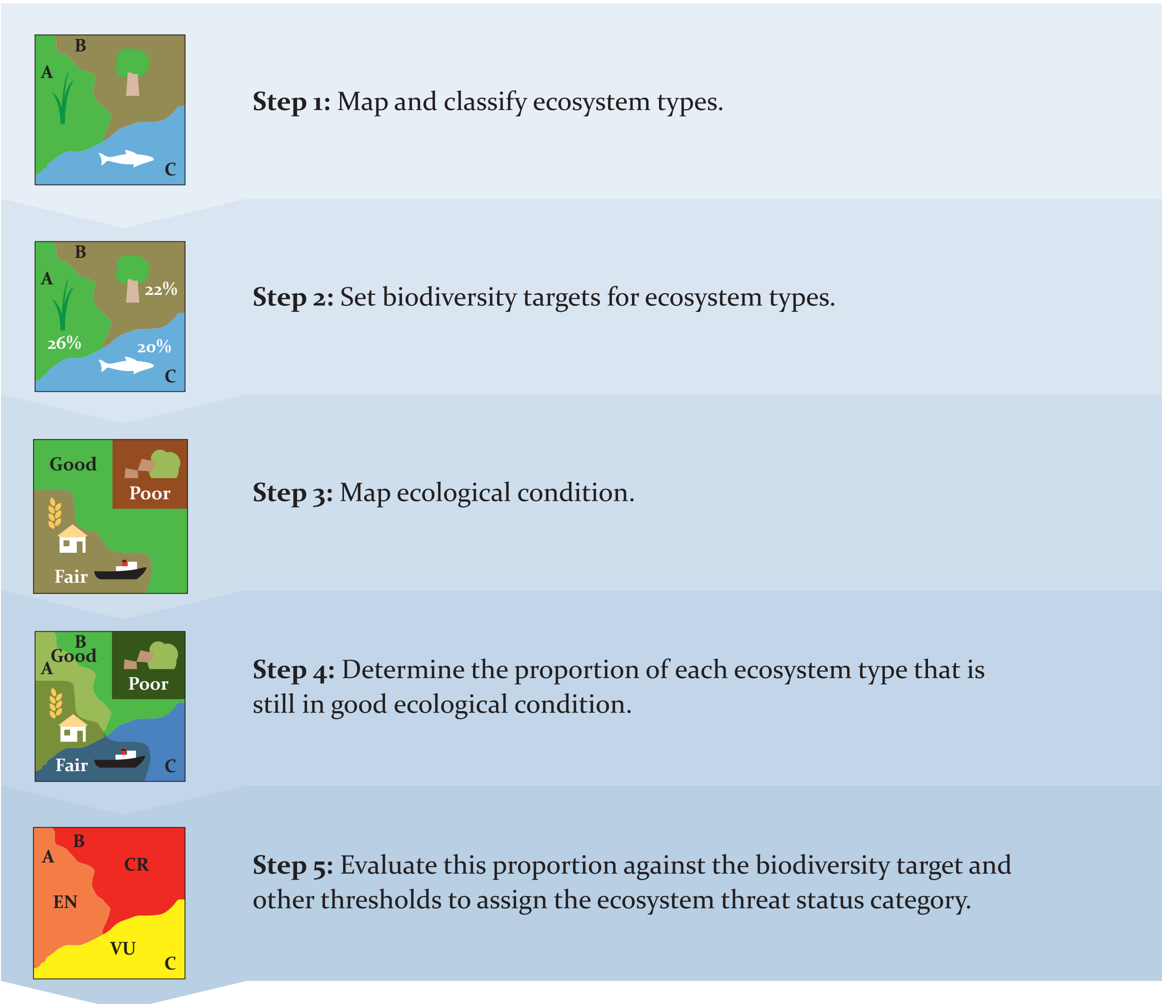


Figure 2: Steps for assessing threat status for each ecosystem type. See Table 7 for more detail on each step.

Ecosystem types can be assigned to an escalating series of categories that describe the degree to which they have been lost or modified and are thus threatened. It can be useful to use threat status categories that are already employed in the conservation sector (such as Critically Endangered, Endangered and Vulnerable). These categories are widely known, easily understood, and provide a familiar assessment of threat status.

The approach for assessing ecosystem threat status presented in Figure 2 and Table 5 is consistent with the recently developed IUCN criteria for the Red List of Ecosystems[8], but is simpler to implement, especially for under-capacitated countries. In essence, the method described here is comparable to Criterion A in the IUCN Red List of Ecosystems, in which the proportion of area of an ecosystem type that remains intact is assessed according to a series of thresholds. Table 5 provides an example of a relatively simple set of categories and thresholds for assessing ecosystem threat status. However, it is not prescriptive and other categories could be equally valid if they were scientifically defensible, quantitative and criteria-based. Our experience has shown that an assessment of ecosystem threat status based just on Criterion A or its equivalent (as shown here) can provide a simple but powerful indicator of the state of biodiversity. This simple assessment of threat status can be a starting point for an expansion to the full set of criteria used in the IUCN Red List of Ecosystems, as capacity and data availability improve.

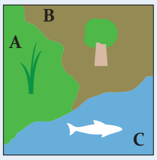
Ecosystem threat status is a very useful guide for conservation action. It is clear that ecosystems that are endemic or near-endemic to a country, and also threatened, should receive particular conservation attention. However, in a few cases national and global assessments of threat status may differ, for example, when a small portion of an ecosystem type is nationally threatened but is widespread and not threatened in other parts of the world. In such cases, a rational decision must be made about conservation action, best done on a case-by-case basis taking into account context-specific factors.

[8]IUCN Red List of Ecosystems. http://iucnrle.org/

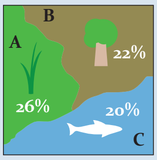
Table 5: Suggested categories and thresholds for the assessment of ecosystem threat status.

Threat status category		Description	Suggested threshold
Threatened	**Critically Endangered (CR)**	Critically Endangered ecosystem types have very little of their historical extent (measured as area, length or volume) left in a natural or near-natural state. Most of the ecosystem type has been moderately, severely or irreversibly modified from its natural state. These ecosystem types are likely to have lost much of their natural structure and functioning, and species associated with the ecosystem may have been lost. Few natural or near-natural examples of these ecosystem types remain. Any further loss of natural habitat or deterioration in condition of the remaining healthy examples of these ecosystem types should be avoided, and the remaining healthy examples should be the focus of urgent conservation action.	Equal to the biodiversity target for the ecosystem type. E.g. 20% of the historical extent of an ecosystem type. See **Section 4.4: Biodiversity targets** for more information.
Threatened	**Endangered (EN)**	Endangered ecosystems are close to becoming Critically Endangered. Any further loss of natural habitat or deterioration of condition in these ecosystem types should be avoided, and the remaining healthy examples should be the focus of conservation action.	A threshold that provides a warning that the ecosystem type is approaching CR status. E.g. The biodiversity target + 15% of the historical extent of the ecosystem type.
Threatened	**Vulnerable (VU)**	Vulnerable ecosystem types still have the majority of their historical extent (measured as area, length or volume) left in natural or near-natural condition, but have experienced some loss of habitat or deterioration in condition. These ecosystem types are likely to have lost some of their structure and functioning, and will be further compromised if they continue to lose natural habitat or deteriorate in condition. Maps of biodiversity priority areas should guide planning, resource management, and decision-making in these ecosystem types.	A threshold for ecological functioning ecosystems related to ecological processes. E.g. 60% of the historical extent of the ecosystem type.
Least Threatened (LT)		Ecosystem types that have experienced little or no loss of natural habitat or deterioration in condition. Maps of biodiversity priority areas should guide planning, resource management, and decision-making in these ecosystem types.	

Ecosystem protection level[G] is an indicator of the extent to which ecosystem types are adequately represented in the protected area network. This differs from a national assessment of total area of the protected area network in that it assigns a protection level to each ecosystem type. The aim is to ensure that representative samples of all the ecosystem types are included within the protected area network. Assessing ecosystem protection level involves overlaying the map of ecosystem types with the map of protected areas to determine the level of protection for each ecosystem type (Figure 3). The proportion of each ecosystem type that is protected is evaluated against the biodiversity target to determine whether it is adequately represented in the protected area network. An example of protection level classification is a system with four categories that includes well represented, moderately represented, poorly represented, or not represented in protected areas (Table 6).

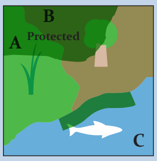


Step 1: Map and classify ecosystem types.

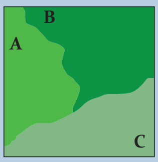


Step 2: Set biodiversity targets for ecosystem types.

Step 3: Map existing protected areas.



Step 4: Determine the proportion of each ecosystem type that is included in the existing protected area network.



Step 5: Evaluate this proportion against the biodiversity target and assign the ecosystem protection level category.

Figure 3: Steps for assessing protection level for each ecosystem type. See Table 7 for more detail on each step.

Table 6: Suggested categories and thresholds for the assessment of ecosystem protection level.

Protection level category		Description	Suggested threshold
Under represented	**Not represented**	An ecosystem type for which no area, or only a very minimal area, is located within the protected area network. These ecosystem types require additional protection.	Less than 5% of the biodiversity target is located within the protected area network. The use of 5% rather than 0% ensures that tiny GIS slivers do not give spurious results.
Under represented	**Poorly represented**	An ecosystem type for which a small area is located within the protected area network, but much less than the area required to meet the biodiversity target. Additional formal protection of these ecosystem types is required.	More than 5%, but less than half of the biodiversity target (50%) is located within the protected area network.
Under represented	**Moderately represented**	An ecosystem type for which a moderate area is located within the protected area network, but less than the area required to meet the biodiversity target. Additional formal protection of these ecosystem types is required.	More than half (50%), but less than the full biodiversity target is located within the protected area network.
Well represented		An ecosystem type for which an area equivalent to the full biodiversity target is located within the protected area network. These ecosystem types require no further formal protection to meet their biodiversity targets. They may still be identified as priorities for formal protection for other reasons, such as considerations related to ecological processes or ecological infrastructure.	

5.2 STEPS FOR CONDUCTING A SPATIAL BIODIVERSITY ASSESSMENT

Calculating the two headline indicators is possible using only the four essential datasets described in **Section 4: Datasets**: a map of ecosystem types, a map of ecological condition, a map of protected areas, and the set of biodiversity targets for ecosystem types. These basic building blocks are combined by simply overlaying the various maps and calculating proportions in relation to the biodiversity targets. While some GIS capability is required, the methods are relatively simple to understand and apply. Table 7 summarises the detailed steps required to complete a biodiversity assessment.

Table 7: Methods and tasks for conducting a biodiversity assessment that will result in a threat status and protection level assessment for each ecosystem type within a country.

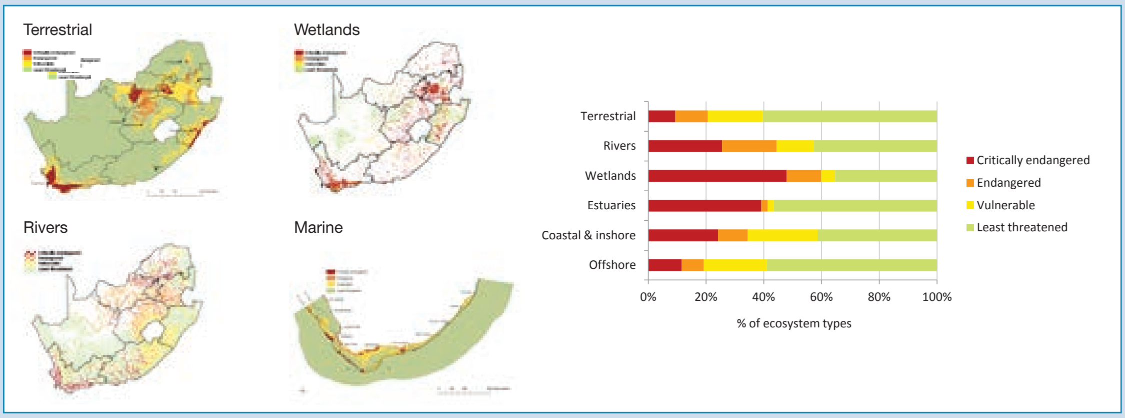
Steps	Tasks	Description and additional notes
Map and classify ecosystem types	Source or develop maps of ecosystem types in all realms	• Information on how to source or generate a map of ecosystem types can be found in **Section 4.1: Map of ecosystem types**. • The ability to map and classify ecosystems into different ecosystem types is essential in order to assess threat status and protection level, and to track changes over time. • Ecosystem types should be mapped based on their historical extent, or their extent at a chosen baseline date.
Set biodiversity targets	Set biodiversity targets for ecosystem types	• Information on setting biodiversity targets can be found in **Section 4.4: Biodiversity targets**. • Targets are usually set as a proportion of the historical extent of each ecosystem type. • A flat biodiversity target of 20% of each ecosystem type can be a pragmatic way to set targets in the absence of data needed to set more sophisticated targets based on the ecological characteristics of different ecosystem types.
Assess ecosystem threat status	Map ecological condition in all realms	• Information on sourcing or generating a map of ecological condition can be found in **Section 4.2: Map of ecological condition**. • Maps of ecological condition combine information on the impact of different drivers of ecosystem change (such as land cover change, alteration of freshwater flows, overharvesting of resources, invasive alien species or climate change) into a single map. • Ecological condition can be helpfully classified into categories of good, fair, and poor condition. • In assessing ecosystem threat status, the portion of each ecosystem type remaining in good ecological condition is considered.
	Decide on threat status categories and set thresholds	• Decide on a set of categories for ecosystem threat status. • Decide on a threshold for each threat status category. • It is useful if the threshold for the highest threat category is equal to the biodiversity target. • Suggested categories and thresholds for ecosystem threat status are given in Table 5.
	Evaluate threat status	• Overlay the map of ecological condition on the map of ecosystem types in a GIS. • Calculate the proportion of each ecosystem type that remains in good ecological condition. • Compare the proportion remaining in good ecological condition to the thresholds. • Assign an ecosystem threat status category to each ecosystem type.

Steps	Tasks	Description and additional notes
Assess ecosystem threat status	Map existing protected areas	Information on sourcing or generating a map of protected areas can be found in **Section 4.3: Map of protected areas**. Decide which categories of protected areas should count towards meeting biodiversity targets.
	Decide on ecosystem protection level categories and set thresholds	Decide on a set of categories for ecosystem protection level. Decide on a threshold for each protection level category. It is useful if the threshold for the highest protection level is equal to the biodiversity target, i.e. an ecosystem type is considered to be well represented if its full biodiversity target falls within the protected area network. Suggested categories and thresholds for protection levels are given in Table 6.
	Evaluate protection level	Overlay the map of protected areas on the map of ecosystem types in a GIS. Calculate the proportion of each ecosystem type that falls within the protected area network. – We recommend that areas in poor ecological condition within protected areas (for example, roads, dams, tourist resorts etc.) are excluded from the calculation. – Rivers often form the boundaries for protected areas, and a decision on whether to consider these rivers protected or not will have to be made. Compare the proportion of each ecosystem type that is protected to the biodiversity target for that ecosystem type. Assign a protection level category to each ecosystem type.
Develop products	Develop products that present the outputs clearly	Provide summaries of ecosystem threat status and protection level in each of the terrestrial, inland water, coastal and marine realms, highlighting the number of threatened and under-protected ecosystem types. Develop simple maps and graphics that clearly display the assessment results. Colours for threat status and protection level categories should match between maps and charts. See **Section 7: Products** for more information and tips on presenting the results of the assessment.

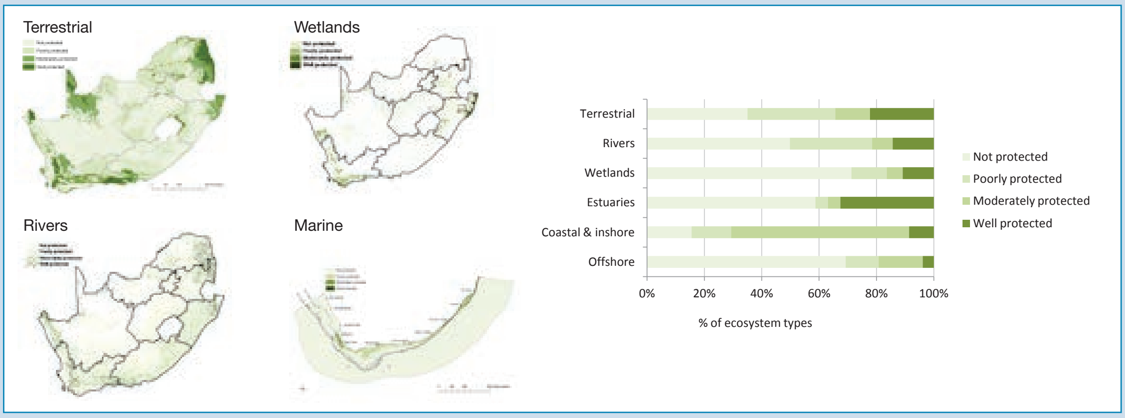
Box 3: Example from South Africa: The headline indicators

The National Biodiversity Assessment (NBA)[9] for South Africa, completed in 2011, provided an assessment of the headline indicators for the terrestrial, inland water, coastal and marine ecosystems of the country (also see Box 1 for more on the origins of the NBA).

Ecosystem threat status: The assessment of threat status in the NBA 2011 showed that wetlands are the most threatened of all of South Africa's ecosystems, with 48% of wetland ecosystem types being classified as Critically Endangered. In the terrestrial environment, the most threatened biomes are the Indian Ocean Coastal Belt, Grasslands, Fynbos, and Forest. Threatened terrestrial ecosystems tend to be concentrated in areas that are hubs of economic production, with the remaining fragments of these ecosystems embedded in production landscapes.



Ecosystem protection level: The assessment of ecosystem protection level revealed that offshore ecosystems are the least protected of South Africa's ecosystems, with only 4% of these marine ecosystem types classified as Well Protected. As many as 35% of South Africa's terrestrial ecosystem types have no representation (or very minimal representation) in the protected area network, and these are mostly found in the Grassland, Thicket, and Nama-Karoo biomes. The NBA found that progress had been made in improving the protection level of 60 terrestrial ecosystem types (out of aproximately 440) since the previous assessment in 2004.



[9] Driver A., Sink, K.J., Nel, J.N., Holness, S., Van Niekerk, L., Daniels, F., Jonas, Z., Majiedt, P.A., Harris, L. & Maze, K. 2012. National Biodiversity Assessment 2011: An assessment of South Africa's biodiversity and ecosystems. Synthesis Report. South African National Biodiversity Institute and Department of Environmental Affairs, Pretoria.

Box 4: Case Study: Assessment and spatial prioritisation for the Arabian Peninsula

In 2013, the approach presented here was applied to the entire Arabian Peninsula[10]. Encompassing eight countries, the peninsula is characterised by extensive desert habitats, which support limited numbers of species, but those that occur are often distinctive and endemic.

The project was delivered at three scales, locally for Abu Dhabi, nationally for the United Arab Emirates (UAE), and regionally for the whole Arabian Peninsula, including Bahrain, Jordan, Kuwait, Oman, Qatar, Saudi Arabia, UAE, and Yemen. This highlights the flexibility of the approach, which can be nested at different scales.

The project gathered data from a wide number of sources, including local government departments responsible for land-use planning, national environmental ministries, and local and global environmental organisations. Significant effort was expended to build an integrated ecosystem map from a range of existing terrestrial vegetation and marine ecosystem maps from the countries and smaller areas where these existed, global bioregional classifications, the stratification of global biophysical data, and the use of expert inputs. Marine and terrestrial maps of ecosystem types were fully integrated into a single dataset. Ecological condition was inferred from spatial data on a range of pressures in the marine and terrestrial environments.

Results showed that inland terrestrial ecosystems in the Arabian Peninsula are generally not threatened, as expected for a desert environment. However, many coastal ecosystems are classified as Vulnerable and are poorly represented in protected areas. Several marine ecosystems are Critically Endangered, especially coral reefs, mangroves and sea-grass beds. Spatial prioritisation was done using MARXAN software and a range of additional data, including data on ecological processes, key species and other economic and planning factors. The prioritisation analysis identified 35 Priority Focus Areas within which conservation actions should be focused.

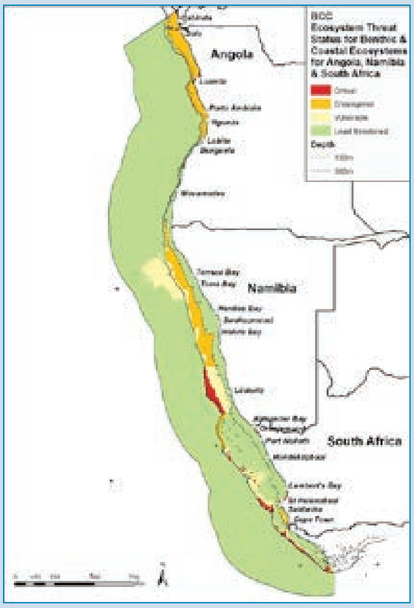
The project outputs are expected to inform protected area expansion, land-use planning and environmental permitting. They will also assist with meeting targets set by the CBD, and providing information for state of the environment reporting.

[10] AGEDI. 2013. Systematic Conservation Planning Assessments and Spatial Prioritizations for the Emirate of Abu Dhabi, the United Arab Emirates and the Arabian Peninsula. Abu Dhabi, UAE.

Box 5: Case Study: Spatial biodiversity assessment and spatial prioritisation for the Benguela Current Large Marine Ecosystem

The cold Benguela current flows northwards along the southwest African coastline, spanning the marine regions of South Africa, Namibia and Angola. The upwelling of nutrient rich water provides habitat for a wide diversity of fish species, migratory seabirds and marine mammals. The high ocean productivity of the ecosystems associated with the current is the basis for an economically important fisheries industry. Since the Benguela Current Large Marine Ecosystem (BCLME) spans three countries, there is a need for integrated management to ensure the protection for its unique ecosystems and sustainable use of its marine resources. In 2014, the Benguela Current Commission initiated a project to develop an integrated conservation plan for the area[11]. The project aimed to replicate and expand the spatial planning approach that had been undertaken for the South African portion of the BCLME to the waters of its neighbours in Namibia and Angola.

An important component of the project was to source and gather existing data for the region. Angola, in particular, had very little spatial data and much of the data for this country had to be derived from existing regional and global datasets. The classification of ecosystem types took into account depth, slope topography, bathymetry, geology, grain size, wave exposure, and available biological and biophysical (remotely sensed) data to identify 134 marine biozones across the BCLME. The result was the first integrated map of ecosystem types for the region, which although still imperfect, is a significant improvement on what was previously available. This map of ecosystem types has significant value for ecology and biodiversity science. Similarly, existing data on pressures on the marine environment were collected and combined using a scoring method that had been applied in South Africa to develop a map of ecological condition for the entire planning area.



Conducting a basic biodiversity assessment by combining the map of ecosystem types and the map of ecological condition resulted in 50 of the 134 ecosystem types being classified as threatened. The majority of the threatened ecosystems were coastal, particularly in Angola and South Africa, as well as shelf edges across the planning area that were associated with fishing. Protection levels varied across the three countries, with Namibia having the highest number of ecosystem types well represented in marine protected areas and Angola the fewest. The project went on to identify a suite of priority focus areas for conservation action, particularly for the expansion of Marine Protected Areas.

[11] Holness, S., Kirkman, S., Samaai, T., Wolf, T., Sink, K., Majiedt, P., Nsiangango, S., Kainge, P., Kilongo, K., Kathena, J., Harris, L., Lagabrielle, E., Kirchner, C., Chalmers, R. & Lombard, M. 2014. Spatial Biodiversity Assessment and Spatial Management, including Marine Protected Areas. Final report for the Benguela Current Commission project BEH 09-01.

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6. Prioritisation

Spatial biodiversity prioritisation identifies areas in which to focus conservation action most urgently, referred to as biodiversity priority areas. Conservation resources are always limited and need to be directed towards the areas of high biodiversity importance and the most urgent conservation needs. Biodiversity priority areas are those parts of the landscape or seascape that are most important for conserving viable representative samples of ecosystems and species, for maintaining ecological processes, or for the provision of ecosystem services. Prioritisation should not be the only way that spatial biodiversity information is incorporated into policy, and should preferably be undertaken only after a spatial biodiversity assessment has been conducted as described in Section 5: Assessment.

While assessment follows a relatively uniform process, prioritisation methods can vary widely depending on the context and purpose. In the following two sub-sections, details are provided on a basic prioritisation that builds directly on the outputs of the assessment, requiring no additional data and minimal extra work, and a full prioritisation that involves additional analysis, can be undertaken with varying degrees of complexity, and may involve additional data and resources.

6.1 BASIC PRIORITISATION

The outputs of spatial biodiversity assessment can be used as the basis for an initial identification of biodiversity priority areas. The most basic type of prioritisation can be achieved by simply combining the threat status and protection level maps created during the biodiversity assessment (see **Section 5: Assessment**). The remaining natural or near-natural areas in those ecosystems that have both high levels of threat and low levels of protection are clearly in need of urgent conservation action. In this way, the outputs of the assessment can provide a rudimentary set of priority areas that can be a powerful tool for informing action and decision-making (see Box 6 for an example).

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Box 6: Example from South Africa: Basic prioritisation – The "Unlucky 13" marine ecosystem types

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The National Biodiversity Assessment 2011 (NBA 2011)[12] made significant advances in biodiversity assessment for the marine realm and assessed ecosystem threat status and ecosystem protection level for all marine ecosystem types in South Africa (see Box 3). By combining the maps of these two indicators, it was possible to identify the 13 ecosystem types that were both Critically Endangered and not represented at all in the protected area network. These ecosystem types were labelled the "Unlucky 13". It was clear that urgent conservation action should be taken to limit pressures on these ecosystems, and to improve their level of protection. The recommendations from the NBA 2011 and subsequent marine biodiversity plans have led to proposals for the declaration of a suite of new offshore marine protected areas that include many of the "Unlucky 13".

[12] Driver A., Sink, K.J., Nel, J.N., Holness, S., Van Niekerk, L., Daniels, F., Jonas, Z., Majiedt, P.A., Harris, L. & Maze, K. 2012. National Biodiversity Assessment 2011: An assessment of South Africa's biodiversity and ecosystems. Synthesis Report. South African National Biodiversity Institute and Department of Environmental Affairs, Pretoria.

6.2 FULL PRIORITISATION

Combining ecosystem threat status and protection level can help to identify those ecosystem types that are the most urgent priorities for action, but does not necessarily show the full suite of biodiversity priority areas needed to meet biodiversity targets for all ecosystem types and for other biodiversity features.

Full prioritisation uses the well-known scientific methodology of systematic conservation planning to identify geographic areas of biodiversity importance. Systematic conservation planning emphasises the need to conserve representative samples of ecosystems and species (the principle of representation), as well as the ecological processes that allow them to persist over time (the principle of persistence), as discussed in **Section 3: Guiding principles**. The prioritisation process identifies a portfolio of biodiversity priority areas that meet these principles. The outputs of full prioritisation are more geographically specific than the outputs of a basic prioritisation that simply combines ecosystem threat status and protection level, as portions within ecosystem types and other fine-scale biodiversity features can be selected, rather than simply whole ecosystem types.

Full prioritisation usually makes use of specialised software that uses algorithms to consider a range of different options for achieving the biodiversity targets across the landscape or seascape (Figure 4). Methods for prioritisation can vary widely, depending on GIS capability, data availability, the purpose of the prioritisation and the context. The information provided here is intended to give a general overview of spatial biodiversity prioritisation, rather than a comprehensive description of all the possible variations.

The configuration of priority areas identified using this method is designed to be spatially efficient (i.e. to meet biodiversity targets in the smallest possible area). It also takes into account aspects such as connectivity in the landscape, to ensure well-functioning ecosystems that improve the likelihood of long-term persistence of biodiversity. It is possible to select a set of priority sites that avoid conflict with other sectors and land-uses, for example, by avoiding areas that have high agricultural or mining potential or that have been earmarked for expansion of settlements. Such conflict avoidance is not always possible, especially for ecosystem types that have very little of their historical extent remaining.

In the prioritisation process, sites in the best possible ecological condition are preferentially selected to meet the biodiversity targets, because they are likely to be the best representatives of the ecosystem types or species concerned and to have the best chance of surviving into the future. Rehabilitation of sites in fair or poor condition is often difficult and expensive, with no guarantee of success. Generally, only if the biodiversity target cannot be met in sites in good ecological condition, and if persistence of the biodiversity feature concerned is possible in a site that is in fair ecological condition, would sites in fair condition be selected as biodiversity priority areas. In rare circumstances, only if no better options exist and if the biodiversity feature concerned is still believed to be present, would a site in poor ecological condition be selected as a biodiversity priority area.

Priority areas based on multi-criteria analysis

Systematic conservation planning is a method for identifying and implementing priority areas for conservation. It aims to provide a comprehensive, target-based approach that identifies an efficient and ecologically sustainable set of priority areas. Some other approaches, such as Key Biodiversity Areas (KBAs), Important Bird Areas (IBAs) or Alliance for Zero Extinction sites (AZEs), aim to identify sites that make significant contributions in their own right towards the global persistence of biodiversity, without comprehensive consideration of these contributions relative to other sites elsewhere. The two approaches are complementary and systematic conservation planning can be used to prioritise among KBAs to design more efficient protected area networks.

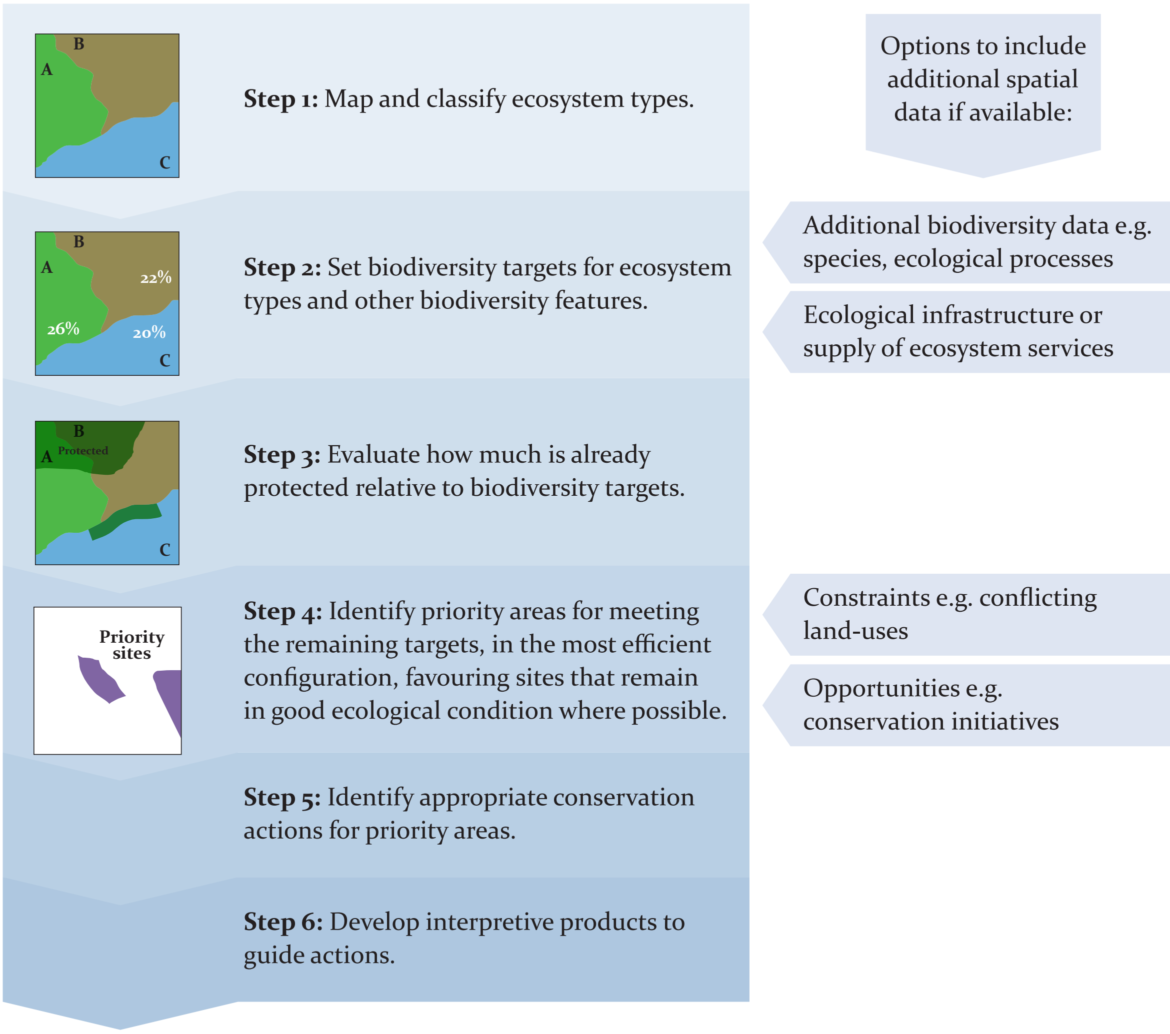

Figure 4: Steps for identifying biodiversity priority areas. See Table 8 for more detail on each step.

Prioritisation can be used for a number of different purposes. Three of the most common are:

- Identifying priority areas in which loss and degradation of natural habitat should be avoided, through informing decisions about land-use across of a range of sectors.
- Identifying priority areas for strengthening and expanding the protected area network.
- Identifying priority areas for rehabilitating degraded ecosystems and restoring ecological infrastructure that provides ecosystem services.

The exact methods of prioritisation may differ depending on the intended use of the maps (especially with regard to the spatial scale of application). Biodiversity priority areas identified for one purpose may not be appropriate for other uses. For example, development of a map intended to inform land-use planning and decision-making at the site scale would require data inputs and analyses at a fine spatial scale, while a map intended to inform broad priorities for conservation action could be based on broader scale inputs and analyses.

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The initial 'raw' spatial output of a prioritisation process is often an irreplaceability map, showing the extent to which there are options for meeting biodiversity targets in different parts of the landscape or seascape. This initial spatial output must then be analysed further to select a portfolio of biodiversity priority areas, which can be shown on a map with a few simple legend categories. **Section 7: Products** gives more advice on creating user-friendly products with accompanying guidelines that provide explanation on how the maps should be used.

Depending on the purpose of the prioritisation, appropriate conservation objectives or actions should be identified for each of the priority areas. For the purpose of informing the NBSAP process, for example, prioritisation can be used to identify high-level strategic objectives, and the broad areas in which these should be addressed. In many cases an initial broad-scale prioritisation at the national level can be used to identify areas in which finer scale prioritisation is needed. Fine-scale prioritisation may not be necessary across the whole country, but could be focused on areas of particular biodiversity importance or areas where pressures on biodiversity are high.

Trade-offs between scope and scale

National prioritisation, conducted at a broad scale, can be useful for identifying priorities for large new protected areas and for prioritising broad areas for increased conservation activities. However, this scale often does not provide detailed enough information for site-level decision-making (for example, to inform land-use decisions at the local level), which may require mapping of biodiversity features and prioritisation at a finer spatial scale.

6.3 STEPS FOR CONDUCTING FULL PRIORITISATION

The amount of data involved, and the computational complexities of evaluating different configurations of priority areas, means that prioritisation is generally conducted with the aid of specialised software. The most frequently used software programmes are *C-Plan*, *MARXAN* and *Zonation*. Use of such software does require additional technical skill and computing capacity relative to undertaking a biodiversity assessment. Table 8 gives the detailed steps required to complete a prioritisation.

! GIS capacity and ecological knowledge

Some of the specialist software required for prioritisation is highly technical and has a steep learning curve. In many countries, there are few people who have both the technical GIS skills and the necessary knowledge of ecology to make full use of such software for spatial biodiversity prioritisation. Any person conducting the spatial analysis for biodiversity prioritisation should either have an understanding of the ecology of the area or work closely with ecologists who do. It is often easier for an ecologist to learn the necessary GIS skills than for a GIS specialist to develop the required ecological understanding.

It is possible to conduct a software-based prioritisation using only the four key datasets described in **Section 4: Datasets**. Outputs of a simple prioritisation such as this will still be valuable to identify priorities for national conservation policy. Refinements to the prioritisation can be made as additional data become available or as methods and capacity improve. There is a whole suite of different options for improving and refining the analysis based on other available data. Some of this data may include:

- Additional spatial data on biodiversity features
  - *Species of special concern*[G]
  - Areas supporting ecological processes, such as corridors
  - Areas important for generating or delivering ecosystem services
- Additional spatial socio-economic data
  - Opportunities, such as existing conservation initiatives
  - Constraints, such as areas with high potential for other land-uses like mining or agriculture or earmarked for future urban expansion

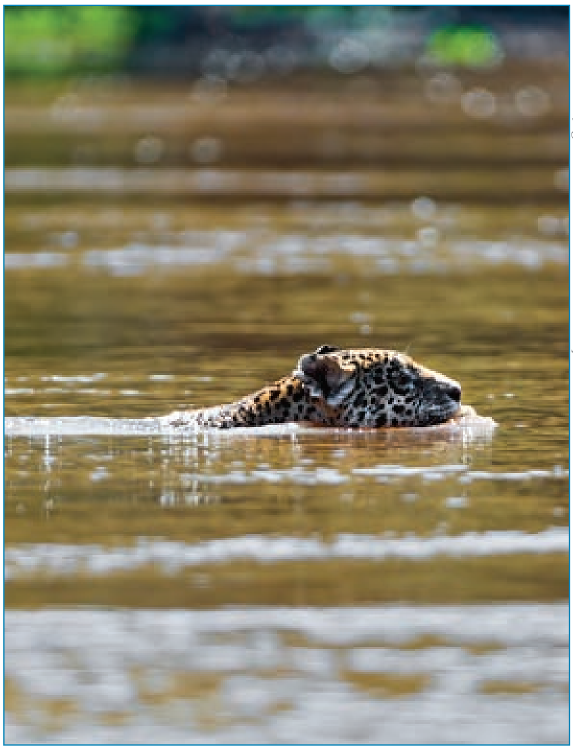


Table 8: Methods and tasks for conducting spatial prioritisation that will result in the selection of a portfolio of biodiversity priority areas across a country.

Steps	Tasks	Description and additional notes
Map and classify ecosystem types	Source or develop a map of ecosystem types	• Start with a map of ecosystem types, as for assessment. • Information on how to source or generate a map of ecosystem types can be found in **Section 4.1: Map of ecosystem types**.
Map other biodiversity features e.g. species distributions, ecological processes	Gather relevant species data	• Decide which species are most important to include, based on clear and defensible criteria. For example, the focus may be on species that are threatened, endemic, rare, or of particular ecological, cultural or socio-economic significance. • Do not feel that simply because data exists for a species, it must be used (see note of caution on species data in **Section 4.6: Other datasets**). • Gather relevant species distribution or locality data, but do not spend too many resources collecting additional species data unless there is a very clear rationale. • As far as possible, use unbiased datasets that reflect the actual distribution of the species concerned, rather than simply well-sampled regions. • Outcomes of other criterion-based prioritisation methods, such as Key Biodiversity Areas or Alliance for Zero Extinction sites, could be included.
	Map relevant ecological processes and ecological infrastructure	• Map key areas for ecological processes where available, such as: – Ecological corridors and upland-lowland gradients that provide for connectivity in the landscape – Areas supporting hydrological processes, such as priority areas for water supply – Riparian corridors, wetlands, and groundwater recharge areas – Areas important for climate change adaptation (for example, areas that may serve as refugia for species that are sensitive to changes in climate) – Key migration routes for species – Large or well-connected patches of natural or near-natural habitat, especially in landscapes that are highly fragmented (e.g. identifying the largest remaining patches of critical habitats) – Important areas for supporting species of special concern (such as breeding areas or movement corridors, if not already included in the species data) • Identify ecological infrastructure i.e. naturally functioning ecosystems that are producing or delivering essential services that contribute to human well-being. For example, areas important for water supply, wetlands important for flood regulation, coastal dunes or mangroves important for natural hazard prevention etc.

Steps	Tasks	Description and additional notes
Set biodiversity targets	Set biodiversity targets for ecosystem types	• Information on setting biodiversity targets for ecosystem types can be found in **Section 4.4: Biodiversity targets**. • Biodiversity targets must also be set for any other biodiversity features included, such as species or ecological process features – Species targets are usually expressed as a percentage of their geographical distribution, but may also include a required population size, number of populations, or a link to a specific life stage (e.g. breeding sites). Targets may be higher for threatened or endemic species. – Care needs to be taken to set appropriate targets for features representing ecological processes. For example, it may be necessary to include the full extent of a key corridor (i.e. to set a target of 100% for this feature) but it may be possible to retain sufficient ecological functioning by including only a proportion of a floodplain system (e.g. to set a target of 50% of this feature).
Consider ecological condition	Map ecological condition and consider the minimum ecological condition required	• Information on sourcing or generating a map of ecological condition can be found in **Section 4.2: Map of ecological condition**. • For each set of biodiversity features, decide on the minimum ecological condition required in order for them to contribute effectively to meeting targets. • This may differ depending on the type of biodiversity feature (e.g. ploughed areas may have no further value for meeting targets for terrestrial ecosystem types, but may still contribute to meeting some ecological process targets e.g. as part of a corridor that allows for movement of some species). • Overlay the ecological condition on each map of biodiversity features (e.g. ecosystem types, species and ecological processes) in a GIS, and remove the parts of each biodiversity feature that are not in at least the minimum required ecological condition.
Determine planning units	Decide on planning units to be used and delineate planning units	• There are many valid approaches for delineating planning units. For example, they can be: – Regular geometric units such as a grid of pixels or hexagons – Ecological units such as catchments – Land management units such as property boundaries • Creating ecologically sensible planning units may require including the entire extent of an ecosystem as a planning unit in cases where it would not make sense to select only part of that ecosystem for protection, for example, the entire across-shore extent of intertidal habitats. • Consider the relationship between the size of the planning units and the resolution of the biodiversity feature data. For example: – Planning units should not dwarf the smallest biodiversity feature – Planning units should not be falsely small relative to the resolution of the biodiversity features • If the units are irregularly sized, avoid large ranges of different sizes, and avoid extremely large planning units. • Protected areas can be treated as single planning units in their own right, or can be subdivided by the planning units used in the rest of the land- or seascape.

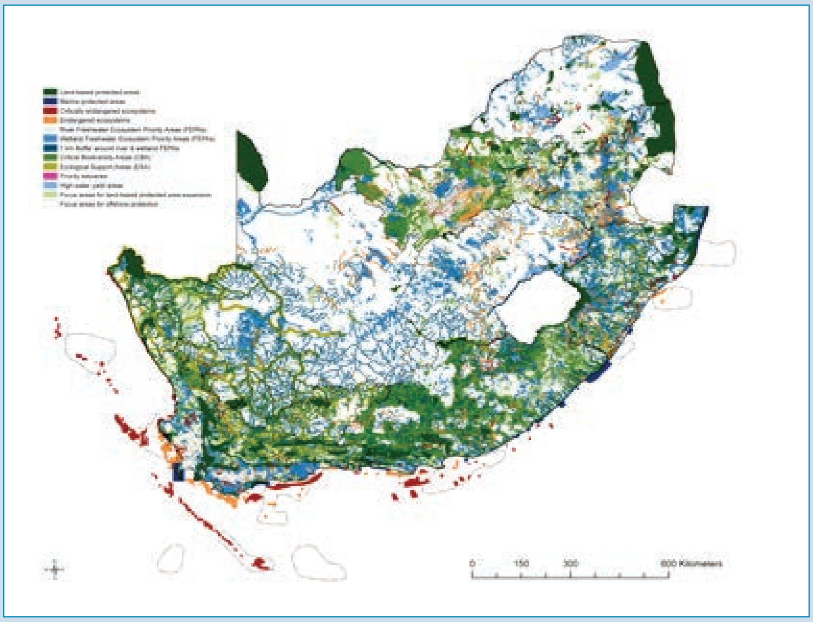
Steps	Tasks	Description and additional notes
Develop a matrix of planning units and features	Create a site-by-features matrix	• For each planning unit, determine how much of each biodiversity feature occurs in that planning unit in at least the minimum required ecological condition for that feature (e.g. how many hectares of habitat in good ecological condition of a particular ecosystem type occur in each planning unit). • Typically, this is done within a specialised piece of software.
	Identify protected planning units	• Identify which planning units fall within the existing protected area network. • Remember that decisions will have to be made as to which categories of protected areas should count towards meeting biodiversity targets (see **Section 4.3: Map of protected areas**).
Evaluate how much is already protected relative to targets	Evaluate how much is already protected relative to targets	• For each biodiversity feature, compare how much is already protected with the biodiversity target for that feature, i.e. determine what proportion of the target has been met. • This is similar to the protection level assessment discussed in **Section 5: Assessment** and provides very valuable information on which biodiversity features are not sufficiently represented in the protected area network. This is often called a gap analysis. • It can be a useful way to draw attention to protected area networks that have become excessively focused on particular aspects of biodiversity (such as charismatic species), and are consequently neglecting other important features (such as an overlooked terrestrial or offshore ecosystem type).
Specify costs for inclusion of planning units	Minimising area or cost	• One key aspect of systematic conservation planning is that it attempts to identify an efficient network of sites which meet targets at the lowest cost and in least conflict with other land-uses and activities. • The simplest approach is to minimise the area selected to form part of the portfolio of biodiversity priority areas. • Areas are assigned to each planning unit, and it is assumed that the cost of protection of a planning unit increases with area. • Ideally, a more realistic assessment of costs for selecting a planning unit could be used, such as the actual costs of land (if prioritising for purchasing land for inclusion in protected areas), but this is not always possible. • Costs do not always refer to financial costs, and other factors (such as constraints or opportunities) can also affect the “cost” of a planning unit. • The cost of a planning unit will affect its selection in the prioritisation process.
	Minimising conflict with other land-uses and activities	• Identify possible constraints – these are factors that should be avoided when selecting priority sites, such as high-potential agricultural land, key areas for fisheries, high-potential mining areas, or areas earmarked for urban expansion. • If possible, gather spatial data on these constraints. • The constraint layers are then used to increase the cost of certain planning units. • Ecological condition can also be used as a cost factor to help prioritise best condition area, by increasing costs of planning units that are not in good ecological condition.

Steps	Tasks	Description and additional notes
Specify costs for inclusion of planning units	Maximising synergies with compatible land-uses and activities	• Identify possible opportunities – these are factors that should be sought out when selecting priority sites, for example, existing conservation initiatives. • If areas that are important for delivering ecosystem services have not already been included as features, it may be useful to include them as factors that reduce the cost of planning units. • The opportunity layers are used to reduce the cost of planning units.
Identify priority sites in the best possible ecological condition for achieving remaining targets, in the most efficient and effective configuration	Select planning units for priority sites	• Use suitable software to identify the planning units required to meet biodiversity targets in a way that is efficient, spatially coherent (e.g. that is arranged in a spatially connected manner that allows ecological processes to operate) and limits costs. • Various software programmes exist to do this, typically using optimisation algorithms. • Be careful to follow available best practice guidelines for the software being used, as some of the software needs to be carefully calibrated to ensure sensible results. • Conflict with other sectors and land-users can be avoided in instances where there are alternative options for meeting targets. This is not always possible, especially for ecosystem types that have very little of their historical extent remaining and for which all that remains is important for meeting biodiversity targets. • Often the initial output of the spatial analysis is an irreplaceability map, which summarises the degree to which options exist in the landscape or seascape for meeting biodiversity targets. • An irreplaceability map requires further interpretation, since it is not a product that will be intuitively understood by a non-technical audience. • Based on the irreplaceability analysis, select a portfolio of priority areas and evaluate it to ensure that targets are met for all biodiversity features. • Where targets are not met, carefully identify why this is the case – it may be necessary to include additional sites in poorer condition to meet targets where insufficient habitat in good condition is available.
Identify appropriate conservation actions for priority sites	Identify appropriate conservation actions for priority sites	• Consider the range of conservation actions or interventions that may be applied to specific priority areas, bearing in mind the biodiversity features in, and pressures on, those areas. • These actions may include: – Expanding the protected area network – Influencing planning, authorisation and permitting processes, such as land-use zoning, environmental impact assessments or water use licensing – Rehabilitating degraded features, e.g. priority wetlands or catchments
Develop interpreted products to guide actions	Consider how products should best be displayed	• Think about how to display the spatial outputs in an understandable way, typically a portfolio of priority areas divided into a small number of categories. • Pay attention to legend categories, colours and terminology, to aid easy understanding. • Think about what accompanying products should be developed e.g. technical reports, metadata, guidelines, implementation manuals, posters, etc. • See **Section 7: Products**, for more information and tips on how to produce professional and insightful products.

Box 7: Example from South Africa: Biodiversity priority areas and priority actions

South Africa has well-established capacity for conducting spatial prioritisation and producing systematic conservation plans. As a result, a number of different prioritisation processes have been conducted, resulting in a suite of areas identified as priorities for different purposes. Some examples of prioritisation exercises include:

- *National Protected Area Expansion Strategy (NPAES)*: South Africa's first NPAES was developed in 2008, with the goal of achieving cost-effective expansion of the protected area network. The NPAES sets ecosystem-specific targets for protected area expansion and identifies geographic focus areas for land-based protected area expansion.
- *National Freshwater Ecosystem Priority Areas (NFEPA)*: A three-year multi-partner project that concluded in 2011, the NFEPA project gathered large amounts of data to identify priority areas within the freshwater environment. The resultant Freshwater Ecosystem Priority Areas (FEPAs) are rivers and wetlands required to meet biodiversity targets for freshwater ecosystems across the country.
- *Strategic Water Resource Areas*: Strategic Water Source Areas are those areas that supply a disproportionate amount of mean annual runoff to a geographical region of interest. These areas are important because they have the potential to contribute significantly to overall water quality and supply, supporting growth and development needs.
- *Critical Biodiversity Areas*: All provinces in South Africa have developed provincial spatial biodiversity plans, usually led by the provincial conservation authority. These plans identify Critical Biodiversity Areas, which are areas required to meet biodiversity targets for ecosystems, species and ecological processes.

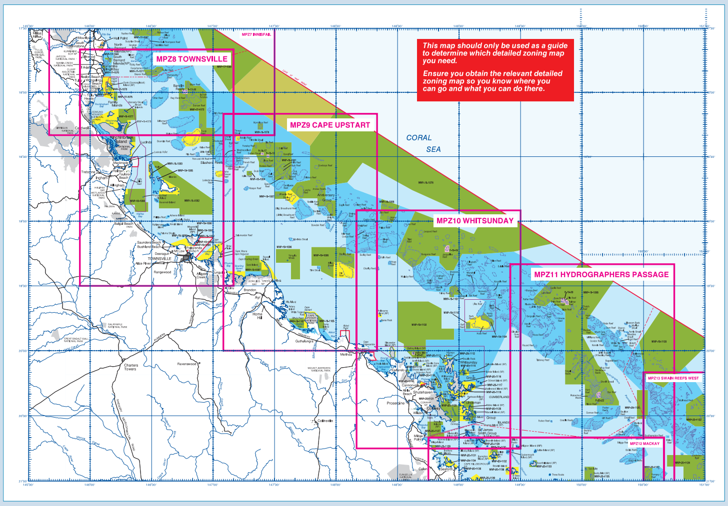


The outputs of these different prioritisation processes were combined into a single map for the National Biodiversity Assessment 2011[13]. The map was accompanied by a set of recommended priority actions, specifically intended to inform the South African NBSAP and other policy documents and processes across a range of sectors. The biodiversity priority areas map has been used in the Environmental Impact Assessment regulations, the Mining and Biodiversity Guideline (jointly published between the Department of Mineral Resources and Department of Environmental Affairs), and in the National Water Resource Strategy.

[13] Driver A., Sink, K.J., Nel, J.N., Holness, S., Van Niekerk, L., Daniels, F., Jonas, Z., Majiedt, P.A., Harris, L. & Maze, K. 2012. National Biodiversity Assessment 2011: An assessment of South Africa's biodiversity and ecosystems. Synthesis Report. South African National Biodiversity Institute and Department of Environmental Affairs, Pretoria.

Box 8: Case study: Spatial biodiversity prioritisation – The Great Barrier Reef zoning plan

The Great Barrier Reef is the largest coral reef ecosystem in the world, and a recognised World Heritage Site. It extends for 2 300 km along the eastern coastline of Australia and contains 3 000 individual reefs, as well as a range of other marine habitats. The first area was proclaimed in 1983, and through progressive additions, the Great Barrier Reef Marine Park now covers 344 400km^2. The whole of the Marine Park is a Marine Protected Area (MPA), but there are different zones of use within the Park.



It was realised in the early 2000s that the zoning was inadequate for protection of biodiversity. Zones needed to be more representative, with the goal of including at least 20% of all bioregions within the highest level no-take zones. The Representative Areas Program conducted the re-zoning, which was completed in 2003[14].

More than 40 datasets were combined to develop the base map of ecosystem types for the reef, resulting in 70 defined "bioregions" – these served as ecosystem types. The MARXAN software, originally developed to conduct this prioritisation for the Great Barrier Reef, has since become one of the standard software options for such analyses worldwide. MARXAN was used to identify priority areas for meeting the biodiversity targets, which were then subject to additional stakeholder input before eight zones were finalised. The re-zoning attracted high levels of stakeholder involvement, including an unprecedented number of submissions from the public. The final step was approval by the Minister for Environment and Heritage, and then the zoning plan was adopted by the Australian parliament.[15]

The zoning maps have been made widely available in easily understood formats, accompanied by guidelines that clearly interpret which activities are allowed or restricted in each zone[16]. In addition, a major research programme has been established to monitor the effects of the re-zoning.

[14] Lewis, A., Slegers, S., Lowe, D., Muller, L., Fernandes, L. & Day, J. 2003. Use of spatial analysis and GIS techniques to re-zone the Great Barrier Reef Marine Park. Coastal GIS workshop, July 7 – 8, 2003, Wollongong, Australia.

[15] Australian Government. 2003. Great Barrier Reef Marine Park Zoning Plan 2003. Great Barrier Reef Marine Park Authority.

[16] Figure shows an example of an overview map. Full Zoning Maps for the Great Barrier Reef Marine Park are available at http://www.gbrmpa.gov.au/zoning-permits-and-plans/zoning/zoning-maps

7. Products

Conducting spatial biodiversity assessment and prioritisation at a national level generates a number of quantitative outputs and maps, with much technical and scientific information embedded in such outputs. While documenting the technical outputs is important for scientific transparency, the outputs often need to be interpreted and displayed with care to reach a wider audience. An important final step for biodiversity assessment and prioritisation should be a conscious focus on creating well-designed products that will be used to inform non-technical stakeholders, such as policy- and decision-makers, managers and the public. It is important to allocate substantial time and sufficient resources for this.

Some of the products that could be produced include:

MAPS

- Ecosystem types
- Ecological condition
- Protected areas
- Ecosystem threat status
- Ecosystem protection level
- Biodiversity priority areas to inform planning and decision-making by a range of sectors
- Protected area expansion priorities

DATASETS

- Spatial data files
- Metadata for spatial datasets
- Spreadsheets

LISTS

- Threatened ecosystems
- Under-protected ecosystems
- National priority areas and actions
- Data gaps and research needs

REPORTS

- Guidelines or manuals for using the maps
- Technical reports
- Summary report for policymakers

Through our experience with communicating the results of national biodiversity assessment and prioritisation at national and sub-national level, several lessons and principles have emerged on how to structure these products most effectively:

Interpret the outputs for easy understanding by a wide general audience. Most stakeholders are not interested in reading technical reports, but prefer a simple summary of the most important findings. A short, diagram-rich, summary report, which clearly describes what the maps and other products mean and what they can be used for, will often be the most widely read resource. Interpretation of the outputs is necessary to not only improve understanding and encourage wider use, but also to avoid misuse. The summary report should distil the scientific findings into a few, easily understandable and well-explained messages that can be used to inform biodiversity policy, as well as contribute to uptake by other sectors and broader audiences.

Keep the message simple, with a few clear points. While acknowledging ecological complexity and scientific rigour, each map product should have a single clear message. Decide on as few headline indicators as possible, and think carefully about the simplest ways to report on these. The summary report should extract a limited set of key messages that are supported by simple and intuitive maps or statistics. Avoid overcomplicating the message by providing too many alternative options or too much detail. For example, rather than trying to explain the multiple options associated with an irreplaceability map, it should be interpreted into a single set of priority sites before being presented as a map product. The choice of appropriate terminology, and limited use of technical jargon, will make the products more comprehensible.

Play close attention to colour and design of map products. Maps are often the primary products of spatial assessment or prioritisation and can convey a great deal of information in a concise and compelling format. The ecologists who conduct the assessment and prioritisation often do not have the graphic design or cartography skills to produce professional and well-designed products. The value of professional presentation should not be underestimated as it can improve understanding of the results and vastly encourage uptake. Colour is an important part of this, and careful choice of colour can help to highlight certain messages, such as using red to indicate only highly threatened ecosystems. Legend categories and terms require careful consideration and should be as self-explanatory and intuitive as possible. Aspects of cartographic design may include adding features that help users orientate themselves on the map, and a shaded relief that makes the map look more realistic. Effort should be made to ensure a consistent design style that will generate a recognisable 'look-and-feel' across the various products. It can be useful to test draft design concepts, especially for maps, with a target set of users.

Create a separate technical report to give evidence of scientific methods. Since the assessment or prioritisation is based on scientific methods, it is necessary for scientific credibility and robustness to provide a technical report that will allow others to query or repeat the methods. While most of the stakeholders will not read this report, it should nevertheless be made available to the scientific community and to anyone else who wishes to understand the underlying science. If the analysis was not integrated across realms, it may be more realistic to produce separate technical reports for the differing methods taken across the terrestrial, inland water, coastal and marine realms. The datasets used as inputs and produced through the analysis should also be made available where appropriate, with strict data management protocols. Datasets should always be accompanied by the necessary metadata describing how they were generated, who the developer was, and what format they are in.

Promote easy access to the products, such as through an online repository. Products should be made available from a central and easily accessible source, ideally curated by a credible national entity that is seen as a source of biodiversity information. Access should preferably be through an online repository that allows downloads of reports, high-resolution pictures of maps, and spatial data in a range of appropriate formats to allow wide usage. For example, maps could be provided as printed posters, downloadable pictures, and in popular GIS formats. Having a single reference point helps users to know where to access final, legitimate products and prevents confusion from distributing multiple versions or revisions (particularly of maps). A clear system of numbering or identifying different versions, will help make it clear which is the latest version. Web traffic and numbers of downloads can give an indication of product usage, and enable this to be monitored over time.

Provide capacity-building and ongoing support to encourage implementation. Plans should be put in place to roll out the products to the user community. Limited capacity, especially within government departments, can mean that despite the best efforts at producing useable products, their purpose is poorly understood and they are simply overlooked by potential users when developing policy, including NBSAPs. Release of the products should ideally be accompanied by information sessions, training and capacity development to promote their full intended use. Innovative use of learning materials, such as wall posters of important maps, can aid instruction. Further, it is vital to provide ongoing assistance to users with interpretation and application of map products and the accompanying guidelines. Once-off training or information sessions are almost always insufficient to ensure uptake.

8. Enabling factors

Several important enabling factors greatly enhance a country's ability to conduct a national biodiversity assessment and prioritisation as described in this document. These factors also improve the likelihood that the results will be taken up into policy, strategy and action planning at a national level. Some enabling factors are:

An agency that can play a co-ordination role. Establishing or identifying a clear organising agency helps to ensure responsibility for co-ordinating the assessment and prioritisation project, disseminating the products, and advising on their uptake into conservation strategies and policies. Ideally, the organising agency should be a public sector conservation agency that is mandated to conduct national biodiversity assessment or monitoring. However, it is possible for a non-governmental organisation to play this role, especially if it works in collaboration with government departments or structures. An organising or champion agency of this type need not be directly involved in conducting the technical aspects of the approach, but should be able to play the role of facilitator and project co-ordinator. The agency should be in a position to add credibility and policy influence if possible, to take responsibility for the outputs and to be a credible, single source for their dissemination. It is beneficial to have the role of project co-ordinator as a core part of someone's job description, allowing enough time for the necessary management and administration.

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Establishing a strong community of practice that promotes peer learning and sharing. Good communication amongst a group of practitioners implementing this approach within a country is important for peer-to-peer learning and consensus building. Regular forums, learning exchanges and other opportunities to build communication channels and solid working relationships can help to improve the technical and scientific methods used, as well as the ways in which the outputs are presented and communicated. Strong communities of practice provide a sounding board for innovation and a peer review mechanism, allowing those working in this field to gain a feeling of peer endorsement and support. Communities of practice also provide a platform for the development of human capacity and a common place of learning for new practitioners. This contributes to the continuity between projects, adaptive learning, and iterative improvement. The co-ordinating agency mentioned above can play a key role in convening such a community of practice, for example through an annual forum or other meetings, events or working groups.

Making clear links to government priorities and processes, to inform national policy. In some cases, external service providers or non-governmental organisations conduct the process of national biodiversity assessment and prioritisation. While this may help to address limited government capacity to run the process, it should not mean that products are imposed upon government without an understanding of government priorities or processes. The national scope of the analysis means that the appropriate 'owner' of the process and products is usually national government. Aligning the process with international obligations, national government mandates, legislation, national priorities, and existing national processes and structures will help to ensure that it is an appropriate and valuable tool for informing national biodiversity policy as well as mainstreaming biodiversity into other sectors.

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9. Conclusion

Perhaps the most valuable aspect of the approach presented in this document lies in the intuitive understanding and wide range of information that can be displayed in a few simple maps. Maps give geographic meaning to a biodiversity assessment, and provide focus areas that can be prioritised in the real world. They are able to communicate important messages about pressures on the natural environment and conservation imperatives to a range of relevant stakeholders.

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The versatility of the maps and other products developed means that there are many relevant uses. National spatial assessments of biodiversity can be used to strengthen environmental decision-making and land-use planning, and to mainstream biodiversity concerns into national development plans, and plans of other sectors. They can also encourage additional strategic research to fill knowledge gaps that are uncovered during the course of the assessment.

Most significantly, the approach presented here can be a valuable informant for national biodiversity strategies and action plans for a country. Policy and decision makers require comprehensive and accessible information to design and implement effective policies for conservation. Countries that include spatial information in their NBSAPs are likely to be better able to plan and implement strategic conservation actions that are effective at a national level. They will also be better able to report and monitor the effectiveness of their conservation actions over the long-term.

Importantly, the spatial information that can be relevant to NBSAPs is within reach of capacity- and resource-constrained countries. This document shows how even a most data-poor country can use available global data as the basis for an initial assessment and prioritisation that will yield useful results. By conducting a national biodiversity assessment in the manner outlined here, countries stand to discover a wealth of information about what biodiversity they have, where it is, its state, and where and how they could act to manage and conserve it.

10. Glossary

Biodiversity: The diversity of genes, species and ecosystems on Earth, and the ecological and evolutionary processes that maintain this diversity.

Assessment: An assessment of the state of biodiversity, at the ecosystem, species or genetic level. The focus in this document is on assessment at the ecosystem level. The output of a biodiversity assessment could be, for example, a map of ecosystem threat status or ecosystem protection level.

Biodiversity feature: An element of biodiversity that is included as an input layer in a systematic conservation plan and for which it is possible to set a quantitative biodiversity target. A biodiversity feature could be, for example, an ecosystem type, a species, a special habitat or an ecological corridor. A map of ecosystem types can often be used as a surrogate for a range of other biodiversity features

Biodiversity priority areas: Areas of the landscape or seascape that are important for conserving representative samples of ecosystems and species, for maintaining ecological processes, or for the provision of ecosystem services. They are usually identified using systematic conservation planning principles and methods. These areas are likely to be the most urgent focus for conservation action.

Biodiversity target: The minimum amount of biodiversity that should be kept in a natural or near-natural state in order to meet the goals of representation and persistence. This could be expressed, for example, in hectares of an ecosystem type or number of populations of a species.

Ecological condition: An assessment of the extent to which the composition, structure and function of an area or biodiversity feature has been modified, varying from areas that remain in a natural or near-natural condition, to those that are severely or irreversibly modified. Natural or near-natural areas are considered to be in good ecological condition, semi-natural or moderately modified areas to be in fair ecological condition, and severely or irreversibly modified areas to be in poor ecological condition. Mapping ecological condition is a way of summarising the many pressures acting on ecosystems.

Ecological infrastructure: Naturally functioning ecosystems that generate or deliver valuable services to people, such as healthy mountain catchments, rivers, wetlands, coastal dunes and corridors of natural habitat. Ecological infrastructure is therefore the asset from which a range of ecosystem services flow.

Ecological processes: The actions and interactions that link organisms and their environment, both at a local scale and at the landscape or seascape scale. These processes are important for the maintenance and persistence of biodiversity over time.

Ecosystem protection level: An indicator of the extent to which different ecosystem types are adequately represented in the existing protected area network. Ecosystems can be categorised into different levels of protection, for example, well represented, moderately represented, poorly represented or not represented.

Ecosystem services: The benefits that people obtain from ecosystems, including provisioning services (such as food and water), regulating services (such as flood control and water purification), and cultural services (such as recreational benefits).

Ecosystem threat status: An indicator of how threatened ecosystems are, in other words, the degree to which ecosystems are still natural or near-natural, or are alternatively losing vital aspects of their structure, function or composition. Ecosystems can be classified into threat status categories, such as Critically Endangered, Endangered, Vulnerable and Least Threatened.

Ecosystem type: An ecosystem unit that has been identified and delineated as part of a hierarchical classification system, based on biotic and/or abiotic factors. Factors used to map and classify ecosystems differ across the terrestrial, inland water, coastal and marine realms. Ecosystems of the same type are likely to share broadly similar ecological characteristics and functioning.

National Biodiversity Strategies and Action Plans (NBSAP): The principal instrument for implementing the Convention on Biological Diversity (CBD) at the national level. Countries are required to prepare a national biodiversity strategy (or equivalent instrument) and to ensure that this strategy is mainstreamed into the planning and activities of all those sectors whose activities can have an impact (positive and negative) on biodiversity. Ideally, a country's NBSAP should be informed by spatial biodiversity assessment and prioritisation.

Natural or near-natural: An ecological condition of natural or largely natural with few modifications resulting from human activity. Also see "Ecological condition".

Persistence: The principle of persistence is one of the two main goals of systematic conservation planning. Persistence refers to the need to maintain ecological and evolutionary processes that enable ecosystems and species to persist over time. In identifying biodiversity priority areas, consideration must be given to the quantity and configuration of sites that will be needed to maintain ecosystem functioning in the long term.

Prioritisation: The identification of a portfolio of geographic areas or sites that are of high importance for conservation action. Prioritisation uses the well-known scientific method of systematic conservation planning to identify a set of efficiently configured priority areas that achieve the goals of representation and persistence.

Protected areas: An area of land or sea that is formally protected by legal or other effective means and managed mainly for biodiversity conservation.

Representation: The principle of representation is one of the two main goals of systematic conservation planning. The aim of representation is to conserve a sufficient sample of all species and all ecosystem types, and to avoid bias towards only certain species or ecosystem types.

Science-based approach: An approach that is based on sound scientific principles and best available scientific data. Other sources of evidence such as expert or indigenous knowledge can also be incorporated. The purpose of using a science-based approach is to ensure transparency, repeatability and defensibility.

Spatial: In this context, spatial refers to geographical location. Spatial information is generally presented on a map.

Species of special concern: Species that have particular ecological, economic or cultural significance, including but not limited to threatened species.

Systematic conservation planning: A scientific method for identifying geographic areas of biodiversity importance, emphasising the need to conserve representative samples of ecosystems and species (the principle of representation), as well as the ecological processes that allow them to persist over time (the principle of persistence). The configuration of priority areas is designed to be spatially efficient (i.e. to meet biodiversity targets in the smallest possible area), to take into account aspects such as connectivity in the landscape, and to avoid conflict with other sectors and land-uses where possible.

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