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Guidelines for using *A Global Standard for the Identification of Key Biodiversity Areas*

Version 1.2



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Guidelines for using

*A Global Standard for the Identification of
Key Biodiversity Areas*

Prepared by the KBA Standards and Appeals Committee of the
IUCN Species Survival Commission and IUCN World Commission
on Protected Areas

Version 1.2

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These guidelines are also freely available online at the Key Biodiversity Areas website (www.keybiodiversityareas.org).

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Charlotte Boyd (Chair of the [KBA Standards and Appeals Committee](#)) is the Chief Editor for the *Guidelines for using a Global Standard for the Identification of Key Biodiversity Areas*.

Abbreviations

AMOVA	Analysis of Molecular Variance
AOH	Area of habitat
AOO	Area of occupancy
AZE	Alliance for Zero Extinction
CLUZ	Conservation Land-Use Zoning software
CR	Critically Endangered
CR (PE)	Critically Endangered (Possibly Extinct)
CR (PEW)	Critically Endangered (Possibly Extinct in the Wild)
DD	Data Deficient
EBSA	Ecologically and Biologically Significant Area
EEZ	Exclusive Economic Zone
EICAT	Environmental Impact Classification for Alien Taxa
EOO	Extent of occurrence
EN	Endangered
ESH	Extent of suitable habitat
EW	Extinct in the Wild
FEOW	Freshwater Ecoregions of the World
FPIC	Free, Prior and Informed Consent
GBIF	Global Biodiversity Information Facility
GIS	Geographic information system
GPS	Global positioning system
IBA	Important Bird and Biodiversity Area
IBAT	Integrated Biodiversity Assessment Tool
ILK	Indigenous and Local Knowledge

IMMA	Important Marine Mammal Area
IPA	Important Plant Area
IUCN	International Union for Conservation of Nature
KBA	Key Biodiversity Area
LC	Least Concern
NCG	National Coordination Group
NT	Near-Threatened
RLE	Red List of Ecosystems
RFP	Regional Focal Point
SIS	Species Information Service
SSC	Species Survival Commission
VU	Vulnerable
WCPA	World Commission on Protected Areas
WDKBA	World Database of Key Biodiversity Areas

Foreword

Purpose of the KBA Guidelines

Key Biodiversity Areas (KBAs) are sites that contribute significantly to the global persistence of biodiversity. A *Global Standard for the Identification of Key Biodiversity Areas* (IUCN, 2016, hereafter the **KBA Standard**) provides criteria and associated quantitative thresholds for identifying KBAs in an objective, repeatable and transparent way.

The purpose of the *Guidelines for using A Global Standard for the Identification of Key Biodiversity Areas* (hereafter the **KBA Guidelines**) is to ensure that KBA identification is based on consistent, scientifically rigorous yet practical methods. The **KBA Guidelines** provide an overview of the steps for identifying and delineating KBAs, together with explanation of how the KBA criteria, thresholds and delineation procedures should be applied in practice. The primary audience for the **KBA Guidelines** includes **KBA Proposers**, **KBA National Coordination Groups (NCGs)** and **KBA Regional Focal Points (RFPs)**.

It is important that the **KBA Standard** remains stable for a period of time to enable comparisons of KBAs across species, ecosystems, and regions and over time. In contrast, the **KBA Guidelines** will be updated periodically, with frequent revisions anticipated in the initial years as experience in applying the **KBA Standard** grows. We expect these updates will be mostly clarifications and additions of detail rather than substantial changes. A summary of the main changes, clarifications and additions in each version is provided in Appendix X. We value input from users — suggestions on how to improve the **KBA Guidelines** may be submitted to chair.kba.sac@keybiodiversityareas.org at any time.

How to use the KBA Guidelines

The [KBA Guidelines](#) should be used hand-in-hand with the [KBA Standard](#), which is available in [English](#), [French](#) and [Spanish](#).

The introduction to the [KBA Guidelines](#) provides background information essential for applying the [KBA criteria](#), [thresholds](#) and delineation procedures. We recommend that users read the introductory chapter in full before initiating any [KBA](#) identification or delineation process.

Five chapters provide guidelines on applying species-based criteria, assessment parameters, ecosystem-based criteria, and criteria based on [ecological integrity](#) and quantitative analysis of [irreplaceability](#). The criteria chapters start with an overview section including a flowchart that summarises the main steps. Detailed guidance for each step is provided in a frequently-asked-questions format. Further chapters cover delineation procedures, stakeholder consultation and involvement, data availability, quality and uncertainty, and reassessment.

Definitions of terms used in the [KBA Standard](#) are provided in Appendix I. A one-page summary of the [KBA criteria](#) and [thresholds](#) is provided in Appendix II.

Detailed supplementary guidance on documentation and the process of submitting a [KBA proposal](#) to the [World Database of Key Biodiversity Areas \(WDKBA\)](#) is provided in the *Key Biodiversity Areas Proposal Process: guidance on proposing, reviewing, nominating and confirming sites* (hereafter the [KBA Proposal Process guidance](#)).

The [KBA Guidelines](#) are designed for use in electronic or printed form. Terms defined in Appendix I are highlighted in [blue](#); related documents or web resources available online are highlighted in [purple](#) (see Appendix IX for links).

1. Introduction

1.1 Key Biodiversity Areas

Key Biodiversity Areas (KBAs) are sites that contribute significantly to the global persistence of biodiversity. The criteria used to identify KBAs incorporate elements of biodiversity across genetic, species and ecosystem levels, and are applicable to terrestrial, freshwater, marine and subterranean systems. KBAs have delineated boundaries and are actually or potentially manageable as a unit. KBAs provide an effective bridge between assessment processes and conservation planning and an important step towards conservation action. However, the process of KBA identification and delineation does not include steps to advance management activity and does not imply that any specific conservation action, such as protected area designation, is required.

1.2 A Global Standard for the Identification of Key Biodiversity Areas

The KBA Standard (IUCN, 2016) defines a set of criteria and associated quantitative thresholds for identifying KBAs in an objective, repeatable and transparent way. The general approach for identifying KBAs was informed by The IUCN Red List of Threatened Species™ (IUCN, 2012a, hereafter the IUCN Red List) and by the Red List of Ecosystems (RLE, Keith et al., 2013), which use criteria and quantitative thresholds to identify threatened species and ecosystem types respectively. Development of the KBA criteria, thresholds and delineation procedures was informed by decades of experience identifying important sites for biodiversity, including Alliance for Zero Extinction (AZE) sites (Ricketts et al., 2005), Important Bird and Biodiversity Areas (IBAs, Donald et al., 2018), Important Fungus Areas (Evans et al., 2001), Important Plant Areas (IPAs, Plantlife International, 2004; Darbyshire et al., 2017), previous iterations of KBAs (Eken et al., 2004; Langhammer et al., 2007), Prime Butterfly Areas (van Swaay & Warren, 2006), Ramsar sites (Ramsar, 2018), Special Protection Areas (Stroud et al., 1990) and Ecologically and Biologically Significant Areas (EBSAs, Dunn et al., 2014). The KBA criteria, thresholds and delineation procedures were subject to an extensive global consultation process. The KBA Standard was approved by the International Union for Conservation of Nature (IUCN) Council and launched at the World Conservation Congress in Hawai'i in 2016.

1.3 Criteria and subcriteria for identifying Key Biodiversity Areas

The **KBA** criteria are explicitly designed to cover all levels of **biodiversity**, including genetic diversity, species and ecosystems. The **KBA** criteria include both species-based criteria similar to those used in the above-mentioned schemes (e.g., **AZE sites**, IBAs), and ecosystem-based criteria designed to identify **sites** that are important for **biodiversity** at the ecosystem level (Table 1.3). Genetic diversity is addressed through its inclusion in assessment parameters used to identify **sites** under several of the species-based criteria.

Collectively, the criteria aim to capture the various ways in which a **site** can be important for the **global persistence** of **biodiversity**. The eleven criteria are grouped into five high-level criteria (A-E). A **site** must **contribute significantly** to the **global persistence** of at least one of the following to qualify as a **KBA**:

- A. **Threatened biodiversity** (Criteria A1-2)
- B. **Geographically restricted biodiversity** (Criteria B1-4)
- C. **Ecological integrity** (Criterion C)
- D. **Biological processes** (Criteria D1-3)

or, it must have:

- E. Very high **irreplaceability**, as determined through quantitative analysis (Criterion E).

The **threatened biodiversity** criterion (A) identifies **sites contributing significantly** to the **global persistence** of *threatened species* (A1) or *threatened ecosystem types* (A2).

The **geographically restricted biodiversity** criterion (B) identifies **sites contributing significantly** to the **global persistence** of *individual geographically restricted species* (B1), *co-occurring geographically restricted species* (B2), *geographically restricted assemblages* (B3), or *geographically restricted ecosystem types* (B4).

The **ecological integrity** criterion (C) identifies **sites** that **contribute significantly** to the **global persistence** of wholly *intact ecological communities* with supporting large-scale ecological processes.

The **biological processes** criterion (D) identifies **sites contributing significantly** to the **global persistence** of demographic *aggregations* (D1), *ecological refugia* (D2), or *recruitment sources* (D3).

The **irreplaceability through quantitative analysis** criterion (E) identifies **sites** that have very high *irreplaceability* for the **global persistence** of **biodiversity** as determined through a **complementarity**-based quantitative analysis of **irreplaceability**.

Table 1.3 KBA criteria and biodiversity elements

Criterion	Genetic diversity	Species	Ecosystems
A. Threatened biodiversity			
<i>A1 Threatened species</i>	X	X	
<i>A2 Threatened ecosystem types</i>			X
B. Geographically restricted biodiversity			
<i>B1. Individual geographically restricted species</i>	X	X	
<i>B2. Co-occurring geographically restricted species</i>	X	X	
<i>B3. Geographically restricted assemblages</i>		X	
<i>B4. Geographically restricted ecosystem types</i>			X
C. Ecological integrity			
<i>C. Ecological integrity</i>		X	X
D. Biological processes			
<i>D1. Demographic aggregations</i>		X	
<i>D2. Ecological refugia</i>		X	
<i>D3. Recruitment sources</i>		X	
E. Irreplaceability through quantitative analysis			
<i>E. Irreplaceability through quantitative analysis</i>		X	

Source: KBA Standard

A **site** needs to meet the **thresholds** for only one criterion or subcriterion to qualify as a **KBA**, but all **sites** should be assessed against as many **KBA** criteria and for as many **taxonomic groups** and **ecosystem types** as possible, given available data. Assessing **sites** against multiple criteria and for multiple **biodiversity elements** will strengthen the robustness of **KBA** identification to changes in the status of particular **trigger** species, **assemblages**, or **ecosystem types**. For example, if a **KBA** is identified for both a **globally threatened** mammal species (under Criterion A1) and an **aggregation** of fish (under Criterion D1), the **site** would remain a **KBA** even if the mammal is reassessed as having lower extinction risk on the **IUCN Red List** and no longer triggers the **KBA**. Assessing **sites** against multiple criteria and for multiple **biodiversity elements** may be an iterative process.

Many of the criteria include subcriteria (e.g., a, b, ...) that describe explicitly how a **site** contributes to the **global persistence of biodiversity** (see Appendix II for a summary). A **site** that qualifies as a **KBA** under Criterion A1 (**threatened species**) subcriterion b, for example, supports at least 1% of the **global population size** and at least 10 **reproductive units** of a species listed as Vulnerable (VU) on the **IUCN Red List** (Fig. 1.3).

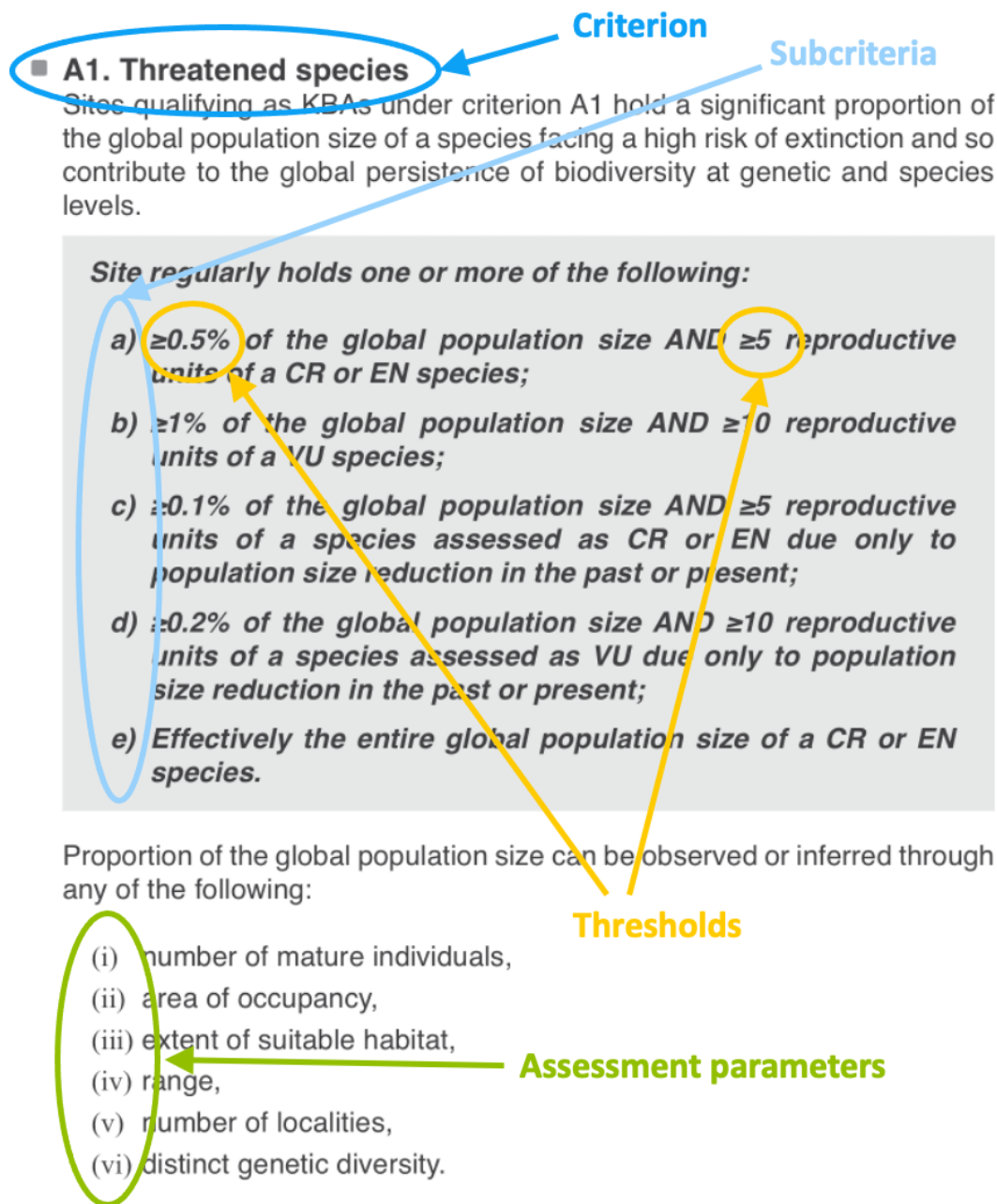


Figure 1.3 Criteria, subcriteria, thresholds and assessment parameters. *Source: Compiled by the KBA SAC.*

Recognition that a **site** meets **KBA thresholds** may be based on one or more assessment parameters. A **site** may be recognised as meeting the **thresholds** for subcriterion A1b, for example, based on the assessment parameters (ii) **area of occupancy** and (iii) **extent of suitable habitat** (Fig. 1.3). This **site** would then be listed as a **KBA** under Criterion A1b (ii, iii).

1.4 Thresholds for identifying Key Biodiversity Areas

The **KBA** criteria have quantitative **thresholds** to ensure that **KBA** identification is objective, repeatable and transparent. The **thresholds** in the **KBA Standard** are designed to identify **sites** that **contribute significantly** to the **global persistence of biodiversity** under each of the **KBA** criteria. These **thresholds** were developed through a series of technical workshops and subsequently refined through wide expert **consultation** and testing with datasets covering diverse **taxonomic groups**, regions and systems. Guidelines for regional application of the **KBA** criteria and **thresholds** will be developed in due course.

The **KBA thresholds** are applicable to all macroscopic species (i.e. excluding **micro-organisms**) and **ecosystem types** in terrestrial, freshwater, marine and subterranean systems. The criteria and **thresholds** are designed to be as simple as possible, while meeting the need for consistent applicability across **biodiversity elements** and systems.

Many **KBA thresholds** are based on proportions of a species' **global population size** or the **global extent** of an **ecosystem type**. For example, a **site** would qualify as a **KBA** under Criterion A1b if it holds at least 1% of the **global population size** of a Vulnerable species (Fig. 1.3), or under Criterion B4 if it holds at least 20% of the **global extent** of an **ecosystem type** (Appendix II). The use of percentage **thresholds** avoids the challenge of identifying fixed numeric **thresholds** (such as a pre-defined number of **mature individuals** or **extent** of an **ecosystem type**) that would be appropriate across all **taxonomic groups** or **ecosystem types**.

Differences in species characteristics are accounted for in parameter definitions that incorporate life-history traits. **Population size**, for example, is measured in terms of **mature individuals**, where the definition of **mature individuals** can be adapted for different life forms, such as clonal colonial organisms. The **thresholds** are thus based on specific parameter definitions presented in the **KBA Standard** and the **KBA Guidelines**; many of these definitions are the same as for the **IUCN Red List**.

The **KBA Standard** is designed to be flexible to enable assessment of species for which there is limited information on **population sizes**. There is therefore a range of assessment parameters that can be used to estimate the proportion of the **global population size** at a **site** if estimates of the number of **mature individuals** are not available. These assessment parameters include **area of occupancy (AOO)**, **extent of suitable habitat (ESH)**, **range**, and number of **localities**.

1.5 Confirmed presence of biodiversity elements in Key Biodiversity Areas

KBA identification requires the confirmed presence at the **site** of one or more **biodiversity elements** (e.g., species, species **assemblage**, or **ecosystem type**) that trigger one or more of the **KBA** criteria. Many species-based criteria have two **thresholds**, one relating to the percentage of the **global population size** held by the **site**, the other relating to the number of **reproductive units** present at the **site**. This second **threshold** is designed to ensure that the species is documented at the **site** in sufficient numbers that the population is capable of maintaining itself beyond the current generation. In the case of Criterion C, a **site** evaluation should be conducted to confirm the presence of fully functional ecosystem types and their components and minimal human impact, using the ecological integrity attributes and associated indicators set out in Section 5.4.

1.6 Climate and environmental change

KBAs may be triggered by species or **ecosystem types** that are **threatened** by future climate change as long as they meet relevant **thresholds** in the present.

The predicted loss of **biodiversity elements** at a **site** that currently meets the **KBA** criteria and **thresholds** due to climate or other environmental change does not preclude its identification as a **KBA**. In such situations, it would be appropriate to document climate change as a threat to the **KBA** (see the **KBA Proposal Process guidance**).

Sites that do not currently meet the criteria and **thresholds** cannot be identified as **KBAs** based on predictions that they will do so in the future as a result of climate change. Models that predict the future occurrence of **biodiversity elements** under specific climate-change scenarios may be important in national and regional conservation planning exercises but cannot be used to identify **KBAs** that do not currently meet the criteria and **thresholds**.

1.7 Key Biodiversity Area boundaries

Delineation is the process of defining the geographic boundaries of a **KBA** and is a required step in the **KBA** identification process. The aim is to derive **site** boundaries that are ecologically relevant and provide a basis for potential management activities. Delineation is an iterative process that typically involves assembling spatial datasets (Section 7.1), deriving initial **KBA** boundaries based on ecological data (Section 7.2), refining the ecological boundaries to yield practical **KBA** boundaries (Section 7.3) and documenting delineation precision (see the **KBA Proposal Process guidance**).

1.8 Stakeholder consultation and involvement

Stakeholder consultation and involvement are important at various stages of the **KBA** identification and delineation process. This includes consultation with knowledge-holders, consensus-building with proposers of existing **KBAs** where a new **KBA** might overlap, and involvement of customary rights-holders.

KBA NCGs and other **KBA Proposers** are encouraged to consult with a range of local knowledge-holders, including **biodiversity** knowledge-holders and local tenure and resource management knowledge-holders, during **KBA** identification and delineation (see Section 8.1).

KBAs should not overlap. If a new **site** proposed as a **KBA** intersects with an existing **KBA** (e.g., an **AZE site**, **IBA** or **KBA** identified under previous initiatives), then consensus-building with proposers of the existing **KBA** is required before any boundaries are modified (see Section 8.2).

The process of **KBA** identification and delineation does not include steps to advance management activity, but confirmation of a site as a **KBA** may lead to new or increased efforts to safeguard the **site**. The involvement of those who hold customary rights to terrestrial, freshwater, marine or subterranean resources is strongly recommended before any action that might affect their rights to those resources (see Section 8.3). In particular, the **Free, Prior and Informed Consent (FPIC)** of Indigenous peoples or other natural resource dependent communities is required when contemplating actions or decisions that could affect rights to lands, territories or resources (**IUCN Standard on Indigenous Peoples**).

1.9 Locally and nationally driven process

KBAs are ideally identified and delineated by local and national constituencies using globally standardised criteria, **thresholds** and delineation procedures. The leading

role of in-country organisations and experts serves to mobilise local [biodiversity](#) knowledge in [KBA](#) identification and enable effective stakeholder consultation and involvement, with the additional benefit of building local and national support for safeguarding [KBAs](#).

Any organisation or individual with appropriate scientific data may serve as a [KBA Proposer](#), proposing one or more [KBAs](#) based on the [KBA Standard](#) and the [KBA](#) identification and delineation process set out in the [KBA Guidelines](#) and the documentation requirements set out in the [KBA Proposal Process guidance](#). In countries with a [KBA NCG](#), [KBA Proposers](#) are strongly encouraged to work in coordination with the [NCG](#). Where there is no [NCG](#), [KBA Proposers](#) should engage with their [KBA RFP](#) early in the process, and are encouraged to reach out to other in-country experts and national representatives of the [KBA Partners](#) to stimulate the establishment of an [NCG](#).

[KBA NCGs](#) play a key role in supporting the identification of a single, comprehensive and harmonised set of [KBAs](#) and promoting their conservation. In particular, [NCGs](#) can ensure that [KBA Proposers](#) are aware of other ongoing efforts to identify new [KBAs](#) or to revise existing [KBAs](#) in the country, so that boundaries can be aligned. In large countries, this role may be supplemented by similar coordination groups working at [ecoregion](#), [bioregion](#), state or provincial levels, as appropriate.

In each region, [KBA RFPs](#), regional representatives of the [KBA Secretariat](#), are available to provide technical support and training to [KBA NCGs](#) and other [KBA Proposers](#). [NCGs](#) and other [KBA Proposers](#) are encouraged to engage with their [RFP](#) early in the process of [KBA](#) identification and delineation.

Please see the [KBA Proposal Process guidance](#) for more details on the role of various actors in proposing, reviewing, nominating and confirming [KBAs](#).

International organisations or experts may conduct various types of desk-based analysis to scope out possible [KBAs](#) in processes that are not locally or nationally driven. Examples include regional and global datasets prepared by the [KBA Secretariat](#) and provided to [KBA NCGs](#) or other [KBA Proposers](#) as an input to local or national [KBA](#) identification processes, analyses by [IUCN SSC Red List Authorities](#) or [IUCN SSC Specialist Groups](#) focused on particular [taxonomic groups](#), and university-based research on various aspects of the application of the [KBA](#) criteria and [thresholds](#). The results of these analyses are not [KBAs](#) until the [KBA](#) identification and delineation process is complete, including delineation of practical boundaries (Section 7.3), consultation and involvement of customary rights-holders and other

stakeholders (Section 8), and confirmation of presence and **reproductive units**. With the exception of the high seas, this will require collaboration with **KBA NCGs** or other in-country organisations and experts.

1.10 Data availability, quality and uncertainty

KBA identification should be based on the most comprehensive and up-to-date data available and the best available methods for quantitative analysis. Nevertheless, it is recognised that the availability of high quality data and quantitative analysis differs significantly among **taxonomic groups** and ecosystems. (See Section 9 for further guidelines on data availability, quality and uncertainty.)

KBA NCGs and other **KBA Proposers** are responsible for ensuring that the data used to support a **site's** qualification as a **KBA** are reasonable and defensible. **KBA** proposals will be reviewed by the **KBA RFP** who may send proposals to additional experts for independent review (see the **KBA Proposal Process guidance**). **Site** assessments that are not based on the best available data may be vulnerable to challenge through a **KBA Appeal**.

1.11 Monitoring of Key Biodiversity Areas

KBA monitoring is essential for improving our understanding of what is happening to **KBAs** in relation to trigger species, ecosystem types and ecological integrity and how these **biodiversity elements** are responding to pressures. Monitoring information is important at the **site**, national, regional and global scale. It enables the design and adaptation of effective conservation actions to safeguard the biodiversity that **KBAs** hold, and may contribute to **KBA** reassessment by providing updated information on **site-level** values of assessment parameters for **trigger biodiversity elements**. **KBA** monitoring data can also be compiled at national and international levels and used to support policy recommendations and advocacy.

1.12 Reassessment of sites as Key Biodiversity Areas

Confirmed **KBAs** should be reassessed against the **KBA** criteria and **thresholds** at least once every 8-12 years, with more frequent monitoring of **biodiversity elements** that triggered **KBA** qualification recommended where possible. Both genuine status changes and new information about the **biodiversity element(s)** triggering **KBA** criteria and **thresholds** may affect the status of a **site** as a **KBA**. Previously confirmed **KBAs** that no longer meet any criteria will no longer be considered **global KBAs**, unless there is reasonable expectation that the **site** will requalify in the near future

through proposed restoration activities (see Section 10 for further guidelines on reassessment of [sites](#) as [KBAs](#)). However, such [sites](#) may still qualify as a regional [KBA](#) following guidelines for regional application of the [KBA](#) criteria (to be developed in due course), and may be highlighted as a conservation success on the [IUCN Green List of Protected and Conserved Areas](#) (hereafter [IUCN Green List](#)) subject to meeting the [IUCN Green List](#) criteria.

1.13 Definitions

Important terms used in the [KBA](#) criteria, [thresholds](#), assessment parameters and delineation procedures have specific definitions, as set out in the [KBA Standard](#) and reproduced and expanded in Appendix I.

The [KBA Standard](#) uses several assessment parameters that are also used in [IUCN Red List](#) or [Red List of Ecosystems](#) assessments (e.g., “[mature individuals](#)”, “[AOO](#)”). The [KBA Guidelines](#) therefore make frequent reference to the [Guidelines for using the IUCN Red List Categories and Criteria](#) (IUCN SPC, 2022) and the [Guidelines for the application of IUCN Red List of Ecosystems Categories and Criteria](#) (Bland et al., 2017), which provide more detailed discussion of these parameters.

1.14 Documentation

[Sites](#) will only be accepted as [KBAs](#) if they are adequately documented. All required documentation should be compiled prior to submission. Documentation provides information to reviewers on the justification for identifying a [site](#) as a [KBA](#) and to decision-makers on why each [KBA](#) is important. Documentation also enables analysis of [KBA](#) data across species, [ecosystem types](#) and regions over time. (See the [KBA Proposal Process guidance](#) for further details.)

2. Identifying Key Biodiversity Areas using species-based criteria (A1, B1-3, D1-3)

This chapter provides detailed guidelines on applying the species-based criteria, A1, B1-3 and D1-3. It is supplemented by Section 3, which provides detailed guidelines on assessment parameters. Criterion E is also species-based, but is covered separately in Section 6 because the identification process differs substantially from that used for Criteria A1, B1-3 and D1-3.

2.1 Overview

The step-by-step process shown below serves to structure the guidelines and is indicative only. In practice, the process of **KBA** assessment is likely to vary among countries and **taxonomic groups**.

KBA NCGs and other **KBA Proposers** are encouraged to conduct a comprehensive scoping analysis (Steps 1-3 in Fig. 2.1) to identify all potential **KBA trigger biodiversity elements** and potential **KBAs** in the region of interest. For species-based criteria (A1, B1-3, D1-3), this scoping analysis should ideally be implemented across multiple **taxonomic groups** simultaneously. For each country, the aim should be to conduct inventories and compile spatial data for as many **taxonomic groups** as possible to improve data availability for lesser-known **biodiversity elements** (e.g., some invertebrates, fungi). **KBA** identification will ideally be based on the same datasets for all criteria for consistency.

KBA NCGs and **KBA Proposers** are also encouraged to conduct comprehensive assessments (Steps 4-10 in Fig. 2.1) covering all potential **KBA trigger biodiversity elements** and potential **KBAs** identified in the scoping analysis for which there are adequate data. Assessing **sites** against multiple criteria and **biodiversity elements** will strengthen the robustness of **KBAs** to changes in the status of particular **trigger species**. Nonetheless, some **KBA Proposers** may wish to focus on identifying **KBAs** for a particular species or **taxonomic group**; whereas others may be primarily interested in a particular **site** and prefer to start by conducting an inventory of **biodiversity elements** that may meet **KBA** criteria and **thresholds** at the **site**.

This chapter includes a section on identifying species that are eligible to trigger **KBAs** (Section 2.2), a section on scoping analysis (Section 2.3), and then a section for each of the species-based criteria, except Criterion E.



Figure 2.1 Overview of possible workflow for applying Criteria A1, B1-3, D1-3. *Source: Compiled by the KBA SAC.*

Is there a maximum number of sites per species?

There is no limit to the number of **sites** that can be identified per **biodiversity element** beyond what is implied by the **thresholds** themselves. For example, the **threshold** for Criterion B1 is 10%, so a maximum of 10 **sites** can be identified under this criterion for a resident species with population evenly distributed among 10 **sites**. Thresholds are

much lower under Criterion A1, raising the possibility that many [sites](#) could be triggered by a single [globally threatened](#) species. In practice, however, the distribution of many [globally threatened](#) species is geographically concentrated, so that each species only occurs at a few [sites](#). For species that are widespread and occur at very low densities, the [reproductive-units thresholds](#) may limit the total number of [KBAs](#).

2.2 Identifying species that are eligible to trigger KBAs

Note. This section also applies to Criterion E (Section 6).

2.2.1 Taxonomy

The species concept used for [KBA](#) identification must be consistent with the species concept used in [IUCN Red List](#) assessments and the database that provides the taxonomic backbone for the [IUCN Red List](#) (i.e. the Species Information Service, SIS). This is essential for the functionality of the [WDKBA](#).

What taxonomy should be used for species that have been assessed for the IUCN Red List?

For species that have been assessed on the [IUCN Red List](#), [KBA Proposers](#) must follow the species concept used in the [IUCN Red List](#).

If there is a proposed change in the treatment of a species or species complex (e.g., a proposed taxonomic split), the SIS, the [IUCN Red List](#) assessment and the [WDKBA](#) must be updated first, before a [KBA](#) can be submitted based on the new information.

If there is a proposed change in nomenclature for the same species concept (e.g., a proposed change from *Morus capensis* to *Sula capensis*), this difference should not delay [KBA](#) assessment. [KBA Proposers](#) can submit a proposal using the current nomenclature, which will be updated in the [WDKBA](#) automatically when it is updated in the SIS.

What taxonomy should be used for species that have not been assessed on the IUCN Red List?

As a first step, [KBA Proposers](#) need to confirm whether the species is included in the SIS, as many species in the SIS have not yet been assessed for the [IUCN Red List](#). [KBA Proposers](#) can liaise with their [KBA RFP](#) who will contact the [IUCN Red List Unit](#) to check.

If a species is not included in the SIS, it must first be added to the SIS, or the taxonomy must be approved by the [IUCN SSC Red List Authority](#) or [IUCN Red List Unit](#) and be in the process of being added to the SIS, before it can be proposed as a [KBA trigger species](#).

For [taxonomic groups](#) that fall under the remit of an [IUCN SSC Red List Authority](#), [KBA Proposers](#) should liaise directly with the designated [IUCN SSC Red List Authority](#) to confirm the taxonomy of any species not yet in the SIS.

For [taxonomic groups](#) that do not have a designated [IUCN SSC Red List Authority](#) (or if the [IUCN SSC Red List Authority](#) is unable to respond in a timely manner), [KBA Proposers](#) should liaise with their [KBA RFP](#), who will ask the [IUCN Red List Unit](#) whether there is an approved checklist (e.g., [Catalogue of Life](#), [World Register of Marine Species](#)) or relevant expert group (e.g., an IUCN Species Survival Commission Conservation Committee) who can advise on taxonomy. The final decision on which taxonomy to follow rests with the [IUCN Red List Unit](#).

Can KBAs be identified for undescribed species?

Undescribed species cannot trigger [KBAs](#), unless the species has been assessed on the [IUCN Red List](#) (see [IUCN Red List Guidelines](#); IUCN SPC, 2022, Section 2.1.1 for conditions under which undescribed species may be listed). In the case of species that are in the process of being formally described through a scientific article that has not yet been published, the [site](#) will not be confirmed for that species until the article has been published and the species has been accepted by the [IUCN SSC Red List Authority](#) or relevant expert group and included in the SIS.

Can KBAs be identified for subspecies or varieties?

The species-based criteria and [thresholds](#) in the global [KBA Standard](#) are designed to be applied at the species level. Subspecies, subpopulations, or varieties cannot trigger [global KBAs](#). For any species, [sites](#) identified at the species level are generally expected to make a more significant contribution to the [global persistence of biodiversity](#) than [sites](#) identified at the subspecies or subpopulation level.

Nevertheless, [sites](#) important for subspecies or genetically distinct subpopulations may trigger [global KBAs](#) based on their [distinct genetic diversity](#) (see Section 3.10). Subspecies and regional subpopulations may also trigger regional [KBAs](#) (following guidelines for regional application of the [KBA](#) criteria to be developed in due course) or national [KBAs](#).

Can KBAs be identified for extinct species?

KBAs cannot be identified for extinct species, but, see Section 2.4.1 for species that are listed on the [IUCN Red List](#) as Critically Endangered (Possibly Extinct) or Critically Endangered (Possibly Extinct in the Wild), and species listed as Extinct in the Wild (EW) that are in the process of reintroduction.

2.2.2 Species only known from their type locality

Can species known only from their type locality trigger a KBA?

Critically Endangered (CR) or Endangered (EN) species known only from their type [locality](#)¹ can trigger subcriterion A1e if it is likely that effectively the entire [population size](#) is regularly held at the [site](#). This information should be available in the [IUCN Red List](#) account. If it is not, [KBA Proposers](#) should check with [IUCN Red List](#) assessors.

Otherwise, [globally threatened](#) species known only from their type [locality](#) may trigger one of the other A1 subcriteria, providing the relevant [reproductive-units threshold](#) is met.

Generally, species known only from their type [locality](#) should not automatically be assumed to trigger [KBA](#) Criteria B1, B2, or B3, without further assessment of whether the species might occur beyond the [site](#). For species that have been assessed for the [IUCN Red List](#), this information should be available in the [IUCN Red List](#) account.

The distribution of species listed as Data Deficient (DD) on the [IUCN Red List](#) is often poorly known. For DD species and other species with limited data, [KBA Proposers](#) should consult with relevant experts (e.g., [IUCN Red List](#) assessors) to evaluate whether the species is likely to occur more widely and, hence, would likely fail to trigger [KBA](#) Criterion B if its distribution was well known. If this consultation reveals that the species is likely to occur more widely, this information should be forwarded to the [KBA Secretariat](#), which will forward new information to relevant [IUCN SSC Red List Authorities](#) on a periodic basis.

Can species without range maps trigger a KBA?

In principle, a [range](#) map should be available for all species before they can trigger a [KBA](#). Some species on the [IUCN Red List](#), including the majority of plant species, have [locality](#) data but no [range](#) map, although such instances should become rare as a [range](#)

¹ The type locality is the single locality where the type specimen (i.e. the scientific name-bearing representative of the species) was collected.

map is now required supporting information for all [IUCN Red List](#) assessments. However, many species are not yet included on the [IUCN Red List](#) and do not have [range](#) maps,

[KBA Proposers](#) are encouraged to develop [range](#) maps for these species following the [IUCN Red List Mapping Standards](#) (see also Appendix III), but a [range](#) map is not required if the assessment parameter is number of [mature individuals](#), number of [localities](#), or [distinct genetic diversity](#).

Species with an [IUCN Red List](#) assessment but no [range](#) map cannot trigger a [KBA](#) that falls outside the [range](#) described in the [IUCN Red List](#) account (including conservation translocations). Please see Section 3.1 if the [range](#) description needs updating.

If the [IUCN Red List](#) account for a species assessed since 2004 does not include a [range](#) map *or* [locality](#) data, this may indicate that distribution data for the species are considered sensitive. [KBA Proposers](#) should review Section 9.1.1 on sensitive data and check with their [KBA RFP](#), who will liaise with the [IUCN Red List Unit](#), before submitting a [KBA](#) proposal for these species.

2.2.3 Migratory species

How are KBAs identified for migratory species?

For migratory species with well-defined spatially segregated [life-cycle processes](#), such as breeding and feeding, Criteria A1, B1-3, D1a and D2 can be triggered separately by [mature individuals](#) in each spatially segregated life function. For example, a CR migratory species may trigger subcriterion A1e if a single [site](#) holds effectively the entire [global population size](#) of breeding adults during the breeding season, even if no [mature individuals](#) are found at the [site](#) during the non-breeding season. The same species could also trigger a separate [KBA](#) under subcriterion A1a if the [site regularly](#) holds $\geq 0.5\%$ of the [population size](#) and ≥ 5 [reproductive units](#) in the non-breeding season. (See Section 3.3 for guidance on [reproductive units](#) for migratory species and Appendix III for details on how [range](#) is assessed for migratory species.)

Criterion D1 is well suited for application to migratory species that form seasonal [aggregations](#), including identification of stop-over or bottleneck [sites](#) along migration routes. Criteria A1 and B1-3 are not generally applicable to stop-over or bottleneck sites as these [sites](#) do not [regularly](#) hold the species.

Multiple KBAs may thus be identified based on the same individuals. The same individuals could contribute to the site-level population size in a species' breeding and non-breeding range under Criteria A1, B1-3, and D1, for example. Under Criterion D1, the same individuals could even trigger KBAs at multiple stop-over or bottleneck sites along the same migration corridor.

2.2.4 Managed and introduced populations

Can KBAs be identified for managed populations?

Only populations that are considered "wild", following the guidance provided in the IUCN Red List Guidelines (IUCN SPC, 2022, Section 2.1.4), can trigger a KBA. There is a continuum of management intensities from captive populations (e.g., in zoos, aquaria and greenhouses) to populations that are not managed in any way. Many populations are dependent on anthropogenic ecosystems (e.g., reservoirs or grazed ecosystems) and/or conservation measures (e.g., protected areas) — these populations are generally considered wild. Captive animal populations and cultivated plant populations are not considered wild. In general, classification as wild should be based on the intensity of management and the expected viability of the population without intensive management. For example, an unmanaged population of a plant species in a botanical garden may be considered wild, whereas a population dependent on heated greenhouses would not. For further guidance, please refer to the IUCN Red List Guidelines (IUCN SPC, 2022, Section 2.1.4).

Can KBAs be identified for introduced or re-introduced populations?

A site that supports an introduced population outside its natural range that is considered wild may be identified as a KBA only if it qualifies as a conservation translocation based on *all* the following conditions:

- (a) The known or likely intent of the introduction was to reduce the extinction risk of the introduced species;
- (b) The site is geographically close to the natural range of the species (see IUCN SPC, 2022, Section 2.1.3 for definition of "geographically close");
- (c) The introduced population has produced viable offspring at the site; and
- (d) At least five years have passed since the conservation translocation.

Conservation translocations are explicitly included in the definition of **range** in the **KBA Standard** and should be included in **IUCN Red List range** maps².

Self-sustaining wild populations that have been re-introduced within the species' natural **range** may trigger a **KBA** and should be included in estimates of **global population size**, regardless of the original goal of the re-introduction. In such cases, conditions (a) and (b) above are not relevant, but conditions (c) and (d) must be met. Please see the **IUCN Red List Guidelines** (IUCN SPC, 2022, Section 2.1.3) for further details.

Please see Section 2.4.1 for the special case of species listed as EW on the **IUCN Red List**.

2.3 Scoping analysis for species-based criteria (A1, B1-3, D1-3)

2.3.1 For each taxonomic group, compile a list of potential trigger species in the region of interest.

For taxonomic groups that have been comprehensively assessed for the **IUCN Red List**³, a list of species known to occur in a particular country can be downloaded from the **IUCN Red List**.⁴

For other **taxonomic groups**, it is recommended that lists of potential **trigger** species are compiled from the **IUCN Red List** and additional sources (e.g., national field guides, checklists, the **National Red List database**, **GlobalTreeSearch**, **FishBase**, **SeaLifeBase**, **World Register of Marine Species**), in consultation with **biodiversity** knowledge-holders (see Section 8.1). Comprehensive lists of potential **trigger** species will likely result in a more complete initial **KBA** assessment, but should not delay or deter **KBA** identification where capacity or resources are limited.

There is no straight-forward way to compile a list of potential **trigger** species for all **KBA** criteria. Guidance on identifying possible **trigger** species is provided in Sections 2.4-2.10 below.

² Associated range polygons should be coded Origin = 6 (Assisted Colonisation). See Appendix III.1 for more information.

³ This includes: selected dicots (Magnoliopsida), conifers (Pinopsida), cycads (Cycadopsida), selected bony fishes (Actinopterygii), birds (Aves), selected reptiles (Reptilia), amphibians (Amphibia), mammals (Mammalia), sharks, rays and chimaeras (Chondrichthyes), selected crustaceans (Malacostraca), selected gastropods (Gastropoda), cephalopods (Cephalapoda) and reef-forming corals (including species from Anthozoa and Hydrozoa).

⁴ Note that the IUCN Red List API (<https://apiv3.iucnredlist.org/api/v3/docs>) provides a useful mechanism for querying the IUCN Red List, including generating species lists by country.

2.3.2 For each potential trigger species, compile available spatial data on the distribution in the region of interest.

Range is defined as the current known limits of distribution of a species, accounting for all known, inferred or projected sites of occurrence, including conservation translocations outside native habitat, but not including vagrancies. **Range** maps for many species that have been assessed for the **IUCN Red List** can be downloaded from the **IUCN Red List** (see Appendix III.1 for detailed guidelines).

ESH maps have already been developed for mammals, birds, reptiles, and amphibians. **ESH** maps for mammals and birds have been validated and will be provided through the spatial downloads page of the **IUCN Red List** in due course.

Validated **AOO** maps can be obtained from the **KBA Secretariat**, if available.

Locality data may be found through a literature search, museum/herbarium records, online databases (e.g., the **Global Biodiversity Information Facility, GBIF**), additional citizen science platforms and direct contact with **biodiversity** knowledge-holders. Some of these data may need to be digitised for use in a geographic information system (GIS). Locality data should be reviewed carefully and filtered to remove unreliable or unverified observations.

2.3.3 Identify the existing/potential sites where each potential trigger species may occur in significant numbers.

One possible approach is to develop a species/site table (e.g., Table 2.3) by overlaying **site** boundaries on spatial data for each species in a GIS. Boundaries of existing **sites** (e.g., existing **KBAs**, other **sites** of importance for **biodiversity**, protected or conserved areas) can be overlaid on species' spatial data to develop a list of existing **sites** where each potential **trigger** species is known to occur (e.g., based on recent well documented **locality** data or validated **AOO** maps), or inferred or projected to occur (e.g., based on **ESH** or **range**). (See the **WDKBA**, **Plantlife IPA Database**, **Ramsar Sites Information Service**, and the **Protected Planet Database** for GIS data on existing **sites**.)

Table 2.3 Example of a species/site table used to identify sites that might qualify under Criterion A1. Additional columns can be added to identify sites under other criteria (e.g., restricted-range for B2, ecoregion- or bioregion-restricted for B3, forms an aggregation at the site for D1). The information in a species/site table can be updated as more information becomes available, with information on the proportion of the global population size held at a site replacing initial notes on known or inferred/projected occurrence.

	IUCN Red List category	IUCN Red List criteria	Migratory	Site 1	Site 2	Site 3
Species 1			no			inferred/ projected
Species 2	EN	A2cd	no		known	known
Species 3			no		inferred/ projected	
Species 4 (breeding)	VU	D1	yes	known		
Species 4 (non-breeding)	VU	D1	yes			inferred/ projected

Source: Compiled by the KBA SAC.

If there are no suitable delineated **sites** in areas of potential importance, initial boundaries for potential **KBAs** may be based on ecological considerations (see Section 7.2). These boundaries may need to be refined later to yield practical **KBA** boundaries (see Section 7.3).

KBA Proposers should review the Justification, Geographic Range and Population sections of **IUCN Red List** for listed species, as well as available spatial data on **range**, **ESH**, **AOO** and **localities** for all proposed **trigger** species to ensure that **KBA** proposals are consistent with this information. Useful information on existing **sites** where a species is currently known to occur may also be found in the Conservation Actions section of the **IUCN Red List** account.

For many species, available data will be limited to **range** and/or **localities**. **Sites** proposed as **KBAs** for a species must fall within the species' **range** (at least partially) and/or include at least one **locality** (see also Section 9.2.3 on confirmation of presence and **reproductive units**). If there are recent known **localities** that fall outside the

mapped [range](#), the [range](#) map should be updated before proceeding (see Sections 3.1 and 3.5). Note that old records are excluded from known [localities](#) and may fall outside the current [range](#) if the species has been extirpated from the area.

If validated [ESH](#) or [AOO](#) maps are also available, [KBA Proposers](#) should also check that proposed [sites](#) fall within the mapped [ESH](#) or [AOO](#) (at least partially) for proposed [trigger](#) species.

For some species and regions, available spatial data may substantially overestimate the area occupied by a species, leading to many false occurrences. In this context, it is recommended that [KBA Proposers](#) work with local experts to review the list or table of existing/potential [sites](#) to confirm likely occurrences before proceeding further. Species lists for existing [sites](#) may also be useful, but note that species lists are often partial and biased towards charismatic species that are easy to identify and may include [vagrants](#).

2.4 Applying Criterion A1 to identify KBAs for threatened species

2.4.1 Identify globally threatened species that may trigger Criterion A1.

The list of [globally threatened](#) species that may trigger Criterion A1 in each country can be found on the [IUCN Red List](#) by searching for species assessed as Critically Endangered (CR), Endangered (EN) or Vulnerable (VU) that occur in each country.

How are globally threatened species identified for the purposes of applying KBA Criterion A1?

The [IUCN Red List](#) is the global standard for species status assessments despite its taxonomic and geographic gaps (Stuart et al., 2010) and using it as the authority for [threatened](#) species increases the rigour and transparency of the [KBA](#) identification process. Species that can trigger [KBA](#) Criterion A1 are:

- species assessed as [globally threatened](#) (i.e. CR, EN or VU) on the [IUCN Red List](#); and
- species that (a) do not have a global [IUCN Red List](#) assessment and (b) are [endemic](#) to the region/country in question and (c) have been assessed as regionally/nationally [threatened](#) following the [Guidelines for Application of IUCN](#)

[Red List Criteria at Regional and National Levels](#) (IUCN, 2012b)⁵ or equivalent systems (see Appendix VI).

If a species' [IUCN Red List](#) threat category has been proposed but not yet accepted or is in revision, the [site](#) will not be confirmed as a [KBA](#) for the species under the new threat category until after the new [IUCN Red List](#) account is published.

The [KBA Standard](#) does not specify any particular version of the [IUCN Red List](#) criteria (IUCN, 2016, p. 16), but the most recent assessment must be used for each species. Species assessed as globally CR, EN or VU under previous versions of the [IUCN Red List](#) criteria that have not been updated may trigger [KBA](#) Criterion A1, but it is strongly recommended that such species are reassessed prior to [KBA](#) identification to confirm that they fall into the same categories under the current criteria and update population and distribution information.

Similarly, if an [IUCN Red List](#) assessment is flagged as “needs updating”, it is strongly recommended that all efforts are made to update the [IUCN Red List](#) assessment prior to [KBA](#) identification. [KBA NCGs](#) and [KBA Proposers](#) are encouraged to develop a list of assessments that need updating early in the [KBA](#) identification process. They may then ask the [KBA Secretariat](#) (through their [KBA RFP](#)) to request that the [IUCN SSC Red List Authorities](#) update assessments for these species.

Can species assessed as Critically Endangered (Possibly Extinct) or Critically Endangered (Possibly Extinct in the Wild) trigger a KBA?

Species listed as CR (PE) or CR (PEW) can only trigger a [KBA](#) under subcriterion A1e, where the site is assumed to hold effectively the entire global population of any surviving individuals. Species listed as CR (PE) or CR (PEW) cannot trigger any of the other [KBA](#) subcriteria or criteria as it is not possible to confirm presence. There is no [reproductive-units threshold](#) for subcriterion A1e, because it is assumed that all (or nearly all) [mature individuals](#) occur at the site.

Species listed as CR (PE) or CR (PEW) can only trigger a [KBA](#) at the [site](#) at which the species is most likely to occur if it still exists. It is recommended that this [site](#) is proposed as a [KBA](#). For many species listed as CR (PE) or CR (PEW), this corresponds to the [locality](#) of the last recorded population. However, in a few cases, the species may never have been recorded at this [site](#) – for example, if the area where the species

⁵ A repository of species assessed at national levels can be found at www.nationalredlist.org. National Red Lists that are based on the Guidelines for Application of IUCN Red List Criteria at Regional and National Levels are flagged. Please email info@nationalredlist.org with any questions.

was previously recorded has been severely degraded, but an adjacent **site** with similar habitat has been well conserved and is now considered the **site** where the species is most likely to occur if it still exists.

Can species assessed as Extinct in the Wild (EW) trigger a KBA?

Sites that hold populations of species listed on the **IUCN Red List** as EW that are in the process of reintroduction within their natural **range** may trigger **KBA** subriterion A1a, c, or e, as appropriate. Reintroduction efforts should either be underway at the time of the **KBA** assessment or planned to take place within the next two years. The **site** will be flagged as “restoration dependent” in the **WDKBA** until the reintroduced population has produced viable offspring at the **site** and at least five years have passed since reintroduction (see Section 2.2.4).

2.4.2 Check the relevant subriterion and population-size threshold for each potential trigger species given its threat category.

For each species that can trigger Criterion A1, the relevant subriterion and **threshold** depends on its category on the **IUCN Red List** (e.g., CR, EN, VU). A **site** qualifies as a **KBA** under Criterion A1 because it **regularly** holds one or more of the following:

- a) $\geq 0.5\%$ of the **global population size** AND ≥ 5 **reproductive units** of a CR or EN species;
- b) $\geq 1\%$ of the **global population size** AND ≥ 10 **reproductive units** of a VU species;
- c) $\geq 0.1\%$ of the **global population size** AND ≥ 5 **reproductive units** of a species assessed as CR or EN due only to **population size** reduction in the past or present (as indicated by the **IUCN Red List** assessment);
- d) $\geq 0.2\%$ of the **global population size** AND ≥ 10 **reproductive units** of a species assessed as VU due only to **population size** reduction in the past or present (as indicated by the **IUCN Red List** assessment);
- e) Effectively the entire **global population size** of a CR or EN species.

Note that a single species may trigger a **KBA** at a **site** under multiple A1 subcriteria (e.g., A1a, A1c and A1e for a CR or EN species that is listed as CR or EN due only to **population size** reduction in the past or present that is effectively confined to a single **site**).

When are subcriteria A1c and A1d applicable?

KBA subcriteria A1a and A1b are intended for general applicability across all **globally threatened** species; whereas subcriteria A1c and A1d are intended for limited application to species that have experienced, or are currently experiencing, rapid

decline in **population size**. Thus, **KBA** subcriteria A1c and A1d apply only to species listed as **globally threatened** under **IUCN Red List** Criterion A (**population size** reduction), but not IUCN Red List Criterion B, C or D. The species must have already experienced or be experiencing this rapid decline, so **KBA** subcriteria A1c and A1d apply only to species listed under **IUCN Red List** subcriteria A1, A2, and/or A4 (**population size** reduction including the past). Species listed only under **IUCN Red List** subcriterion A3 (**population size** reduction in the future) cannot serve as **trigger** species for **KBA** subcriteria A1c and A1d. For example:

- **KBA** subcriterion A1c would apply to a species listed as CR A2 or to a species listed as CR A2; E, but not to a species listed as CR A2; C2; D.
- **KBA** subcriterion A1c would apply to a species listed as CR A2+A3+A4, but not to a species listed only as CR A3.

These guidelines are based on the current **IUCN Red List** Categories and Criteria (Ver. 3.1; IUCN, 2012a). **KBA** subcriteria A1c and A1d cannot be applied to species assessed against previous versions of the **IUCN Red List** Categories and Criteria (e.g., Ver 2.3).

What is meant by “effectively the entire global population size” in KBA subcriterion A1e?

A **site** is considered to hold “effectively” the entire **global population size** of a CR or EN species if it holds more than 95% of the **global population size**. This is the **threshold** used in identifying **AZE sites** (Ricketts et al., 2005). The entire **global population size** refers to the population in the wild, not including individuals in captivity. (Please see Section 2.2.3 for application to migratory species.)

In case of uncertainty, a CR or EN species can trigger subcriterion A1e if it is more likely than not that the **site** regularly holds effectively the entire **population size**, i.e. there is a greater than 50% chance that the **site population size** exceeds the 95% threshold. (See Section 9.3 for more detailed discussion about handling uncertainty.)

2.4.3 For each potential trigger species, identify assessment parameters for which reliable global and local level data are available, and estimate these parameters at the global and site level for all sites where the species may meet the relevant threshold.

For each potential **trigger** species, review the available data at **global** and local levels and decide which assessment parameters to use, then estimate **global** and **site-level** values for those parameters.

For Criterion A1, the proportion of the **global population size** at a **site** can be observed or inferred through any of the following:

- (i) number of **mature individuals**,
- (ii) **area of occupancy**,
- (iii) **extent of suitable habitat**,
- (iv) **range**,
- (v) number of **localities**,
- (vi) **distinct genetic diversity**.

See Section 3.1 for guidelines on selecting among assessment parameters.

2.4.4 Assess whether each potential trigger species meets the relevant population-size threshold at each existing/potential site.

For each **globally threatened** species, **KBA Proposers** should calculate the proportion of the **global population size** that **regularly** occurs at each **site** based on the estimated **global** and **site-level** values for each assessment parameter, and then compare that to the relevant population-size **threshold** for the species given its threat category. This calculation will be checked in the **WDKBA** when it is fully functional.

2.4.5 Confirm the presence of each potential trigger species that meets the relevant population-size threshold at each proposed site.

The final step in assessing a **site** against **KBA** Criterion A1 is to confirm the presence of each potential **trigger** species at the **site** by reviewing recent data, requesting information from local **biodiversity** knowledge-holders or conducting new field surveys if necessary. In some cases, the **IUCN Red List** account provides the information required to confirm the presence of potential trigger species at proposed **sites**.

For subcriteria A1a-d, the species must be **regularly** present in numbers that meet or exceed the relevant **reproductive-units threshold** (see Section 3.3). The **reproductive-units thresholds** are an intrinsic component of the A1 **thresholds** (except for subcriterion A1e) and are intended to prevent identification of **KBAs** where the species occurs in very low numbers and the population is unlikely to maintain itself beyond the current generation.

If available data indicate that a **site** holds at least 10 **reproductive units** of a species listed as CR or EN, **KBA Proposers** are encouraged to provide that information, even though only 5 **reproductive units** are required for CR and EN species, as this may prove useful if the species is downlisted in the future.

There is no **reproductive-unit** requirement for subcriterion A1e. Nevertheless, with the exception of species listed as CR (PE) or CR (PEW) on the **IUCN Red List**, it is still

necessary to confirm that the species **regularly** occurs at the **site** (see Section 9.2.3). If data are available on **reproductive units**, **KBA Proposers** are encouraged to provide that information as it may prove useful if the species' status changes and it no longer qualifies as an A1e **trigger** species in the future.

2.4.6 Refine ecological boundaries, if necessary, to yield practical KBA boundaries.

KBA delineation is not complete until ecological boundaries have been evaluated and refined, if necessary, to yield a **manageable site** or **sites** (see Section 7.3 for guidelines on delineation).

2.4.7 Compile required and recommended documentation under Criterion A1.

See the **KBA Proposal Process guidance** for required and recommended documentation for Criterion A1.

2.5 Applying Criterion B1 to identify KBAs for individual geographically restricted species

2.5.1 Identify species that may trigger Criterion B1.

Any species whose population or distribution is so concentrated that 10% or more of the **global population size regularly** falls within a **site** can trigger a **KBA** under B1.

How are geographically restricted species identified for the purposes of applying KBA Criterion B1?

For the purpose of identifying **KBAs** under Criterion B1, there is no need for the species to be identified as **restricted-range** (as per Criterion B2) or restricted to an **ecoregion** or **bioregion** (as per Criterion B3). Some species with broad global distributions have many individuals concentrated in just a few areas within their **range** limits and may thus trigger Criterion B1. Any species whose population or distribution is so concentrated in certain places that $\geq 10\%$ of the **global population size regularly** occurs in a single **site** may trigger a **KBA** under Criterion B1.

Can migratory species trigger Criterion B1?

The **KBA Standard** states that “the regular occurrence of all life stages of a species at a **site** distinguishes Criterion B1 from Criterion D1” (IUCN, 2016, p. 18). Here, the **KBA Guidelines** clarify that Criterion B1 may apply to resident or migratory species as long as at least 10% of the **global population size** and at least 10 **reproductive units** of the

species **regularly** occur at the **site**. Some **sites** may qualify as **KBAs** under B1 and D1 for the same species, provided that the **aggregation** definition for D1 is met.

Criterion B1 should be applied separately to each spatially segregated **life-cycle process**. For example, a migratory species may be **geographically restricted** in its breeding **range**, but not in its non-breeding **range**, or *vice versa*. (See Appendix III for details on how **range** is assessed for migratory species.)

In contrast, Criterion D1 is intended to apply to highly mobile species (e.g., migratory or nomadic species) that **aggregate** at particular **sites** at high densities (see Section 2.8).

2.5.2 The Criterion B1 threshold is 10% and 10 reproductive units for all species.

A **site** qualifies as a **KBA** under Criterion B1 because it **regularly** holds $\geq 10\%$ of the **global population size** AND ≥ 10 **reproductive units** of a species.

2.5.3 For each species, identify assessment parameters for which reliable global and local level data are available, and estimate these parameters at the global and site level where the species may meet the 10% threshold.

For each potential **trigger** species, review the available data at **global** and local levels and decide which assessment parameters to use, then estimate **global** and **site-level** values for those parameters.

For Criterion B1, the proportion of the **global population size** at a **site** can be observed or inferred through any of the following:

- (i) number of **mature individuals**,
- (ii) **area of occupancy**,
- (iii) **extent of suitable habitat**,
- (iv) **range**,
- (v) number of **localities**,
- (vi) **distinct genetic diversity**.

See Section 3.1 for guidelines on selecting among assessment parameters.

2.5.4 Assess whether each potential trigger species meets the 10% threshold at each existing/potential site.

For each potential **trigger** species under Criterion B1, **KBA Proposers** should calculate the proportion of the **global population size** that **regularly** occurs at each **site** based on the estimated **global** and **site-level** values for each assessment parameter, and then compare that to the 10% population-size **threshold** for Criterion B1. This calculation will be checked in the **WDKBA** when it is fully functional.

2.5.5 Confirm the presence of each potential trigger species that meets the 10% threshold at each proposed site.

The final step in assessing a [site](#) against [KBA](#) Criterion B1 is to confirm the presence of each potential [trigger](#) species at the [site](#) in numbers that meet or exceed the [10 reproductive units threshold](#) (see Section 3.3) by reviewing recent data, requesting information from local [biodiversity](#) knowledge-holders or conducting new field surveys.

2.5.6 Refine ecological boundaries, if necessary, to yield practical KBA boundaries.

[KBA](#) delineation is not complete until ecological boundaries have been evaluated and refined, if necessary, to yield a [manageable site](#) or [sites](#) (see Section 7.3 for guidelines on delineation).

2.5.7 Compile required and recommended documentation under Criterion B1.

See the [KBA Proposal Process guidance](#) for required and recommended documentation for Criterion B1.

2.6 Applying Criterion B2 to identify KBAs for co-occurring geographically restricted species

2.6.1 For each taxonomic group, identify restricted-range species that may trigger Criterion B2.

The first step in applying Criterion B2 is to identify the appropriate [taxonomic group](#) for applying this criterion. A list of standard [taxonomic groups for applying Criteria B2 and B3](#) is provided on the [KBA website \(Tools page\)](#).

The second step is to identify the [restricted-range](#) species for each [taxonomic group](#) that occur in the country or region of interest. A list of all species that have been assessed for the [IUCN Red List](#) that qualify as [restricted-range](#)⁶ is provided on the [KBA website \(Tools page\)](#). For other species, [KBA Proposers](#) are encouraged to review the guidelines below and consult with their [KBA RFP](#) before proceeding with [site](#) assessments.

[Site](#) analysis should be conducted separately for each [taxonomic group](#). [Restricted-range](#) species from different [taxonomic groups](#) cannot be combined to meet Criterion B2. (For example, if 1 bird species and 1 reptile species qualify as potential B2 [trigger](#)

⁶ The 10,000 km² default threshold will be used for any taxonomic group that has not yet been comprehensively assessed.

species at a [site](#), they cannot be combined to trigger a [KBA](#) under Criterion B2. However, a [site](#) can qualify as a [KBA](#) under Criterion B2 for both birds and reptiles, if 2 bird species and 2 reptile species qualify as B2 [trigger](#) species at the [site](#).)

How is the appropriate taxonomic group for applying Criterion B2 determined?

Criterion B2 may be based on any [taxonomic group](#) above species (IUCN, 2016, p. 19). Taxonomic levels in the [standard list of taxonomic groups for applying Criteria B2 and B3](#) were selected based on expert input, with the aim of achieving greater consistency in group size than would be possible if the same taxonomic level was used for all species. Most [taxonomic groups](#) in this list have 10,000-50,000 species according to the [Catalogue of Life](#). For example, the recommended taxonomic level is Class for amphibians (~8,000 species) and for reptiles (~10,350 species). In comparison, the class of flowering plants Magnoliopsida has approximately 260,000 species, so Order is used instead (e.g., Ericales with ~14,000 species; Gentianales with ~22,750 species).

Working at lower taxonomic levels would generally make it less likely that 2 or more potential [trigger](#) species would co-occur at the same [site](#), as required by the species [threshold](#) for Criterion B2. If a KBA Proposer wants to apply a different taxonomic level to that proposed in the standard [taxonomic groups for applying Criteria B2 and B3](#), please contact the [KBA Secretariat](#) first to discuss this.

How are restricted-range species identified for the purposes of applying KBA Criterion B2?

For the purpose of identifying [KBAs](#) under Criterion B2, the [KBA Standard](#) defines [restricted-range](#) species as:

- species with a [global range](#) size less than or equal to 10,000 km², and
- the 25% of species in the [taxonomic group](#) with the smallest [ranges](#) up to a maximum of 50,000 km².

(Please see Appendix I for the full definition.)

Can KBA Criterion B2 be applied to migratory species?

In the case of migratory species, Criterion B2 may be applied separately to each spatially segregated [life-cycle process](#). For example, a migratory species that is [restricted-range](#) in its breeding [range](#), but not in its non-breeding [range](#), could only trigger [KBAs](#) under Criterion B2 in its breeding [range](#); whereas a migratory species that is [restricted-range](#) in its breeding and non-breeding [range](#) could trigger [KBAs](#)

under Criterion B2 in both its breeding **range** and non-breeding **range**. (See Appendix III for details on how **range** is assessed for migratory species.)

2.6.2 The Criterion B2 threshold is 1% for all restricted-range species.

A **site** qualifies as a **KBA** under Criterion B2 because it **regularly** holds $\geq 1\%$ of the **global population size** of each of a number of **restricted-range** species in a **taxonomic group**, determined as either ≥ 2 species OR 0.02% of the global number of species in the **taxonomic group**, whichever is larger. For example, if the total number of species in the **taxonomic group** is 20,000, the **threshold** number is 4. As most standard **taxonomic groups** for applying **Criteria B2 and B3** have 10,000-50,000 species, the **species threshold** will be 2-10 species for most groups.

The standard list of **taxonomic groups for applying Criteria B2 and B3** includes information on the global number of species in the **taxonomic group** and the **threshold** number of **restricted-range** species that must co-occur at a **site** to trigger a **KBA** under Criterion B2.⁷

2.6.3 For each species, identify assessment parameters for which reliable global and local level data are available, and estimate these parameters at the global and site level for all sites where the species may meet the 1% threshold.

For each potential **trigger** species, review the available data at **global** and local levels and decide which assessment parameters to use, then estimate **global** and **site-level** values for those parameters.

For Criterion B2, the proportion of the **global population size** at a **site** can be observed or inferred through any of the following:

- (i) number of **mature individuals**,
- (ii) **area of occupancy**,
- (iii) **extent of suitable habitat**,
- (iv) **range**,
- (v) number of **localities**,
- (vi) **distinct genetic diversity**.

See Section 3.1 for guidelines on selecting among assessment parameters.

⁷ Note that exact information on the global number of species is not required. If the number is less than 15,000, then the species threshold is 2 restricted-range species (species thresholds are rounded down). If the number is greater or equal to 15,000, then the species threshold is 0.02% of the global number of species in the taxonomic group (e.g., a taxonomic group containing 15,000-19,999 species would require 3 restricted-range species in the taxonomic group to co-occur at the site).

2.6.4 Assess whether each potential trigger species meets the relevant population-size threshold at each existing/potential site.

For each potential **trigger** species under Criterion B2, **KBA Proposers** should calculate the proportion of the **global population size** that **regularly** occurs at each **site** based on the estimated **global** and **site-level** values for each assessment parameter, and then compare that to the 1% **population-size threshold** for Criterion B2.

KBA Proposers should then compare the number of species that meet the **population-size threshold** at the **site** to the species **threshold** for Criterion B2, given the global number of species in the **taxonomic group**.

These calculations will be checked in the **WDKBA** when it is fully functional.

2.6.5 Confirm the presence of each potential trigger species that meets the relevant population-size threshold at each proposed site.

The final step in assessing a **site** against **KBA** Criterion B2 is to confirm the presence of each potential **trigger** species at the **site** by reviewing recent data, interviewing **biodiversity** knowledge-holders, or conducting new field surveys.

How can species presence be confirmed at a site for Criterion B2 given that there is no reproductive-units threshold?

While there is no explicit **reproductive-units threshold** for Criterion B2, numbers and densities of **mature individuals** should be sufficient to support reproduction at **sites** within the breeding **range**. **KBA Proposers** must confirm the presence of potential **trigger** species at the **site** and are asked to report this in terms of **reproductive units** (see Section 3.3), where this information is readily available (using the 10 **reproductive units threshold** for Criterion B1, for example). This is especially important for **threatened** species, which may meet the population **threshold** despite very low numbers of **mature individuals**. Criterion B2 should not be used as an alternative to Criterion A1 for proposing **sites** for **threatened** species without providing data on **reproductive units**.

2.6.6 Refine ecological boundaries, if necessary to yield practical KBA boundaries.

KBA delineation is not complete until ecological boundaries have been evaluated and refined, if necessary, to yield a **manageable site** or **sites** (see Section 7.3 for guidelines on delineation).

2.6.7 Compile required and recommended documentation under Criterion B2.

See the [KBA Proposal Process guidance](#) for required and recommended documentation for Criterion B2.

2.7 Applying Criterion B3 to identify KBAs for geographically restricted assemblages

2.7.1 For each taxonomic group, identify species that may trigger the relevant subcriterion.

The first step in applying Criterion B3 is to identify the appropriate [taxonomic group](#) for applying this criterion. A list of standard [taxonomic groups for applying Criteria B2 and B3](#) is provided on the [KBA website \(Tools page\)](#).

The second step is to determine whether subcriterion B3a, B3b or B3c is applicable to the [taxonomic group](#). Information on whether B3a or B3b is applicable is included in the list of [taxonomic groups for applying Criteria B2 and B3](#).

The third step is to identify the potential [trigger](#) species that occur in the country or region of interest for each [taxonomic group](#). For [taxonomic groups](#) that have been comprehensively assessed⁸:

- if B3a is applicable to the [taxonomic group](#), a list of [ecoregion](#)-restricted species will be provided on the [KBA website \(Tools page\)](#);
- if B3b is applicable to the [taxonomic group](#), a list of [bioregion](#)-restricted species will be provided on the [KBA website \(Tools page\)](#) in due course.

[KBA proposers](#) should follow the guidelines below for other [taxonomic groups](#).

If neither B3a or B3b is applicable to the [taxonomic group](#) in a region, [KBA Proposers](#) interested in applying B3c should identify species in the country or region of interest that have been surveyed using systematic and quantitative methods at numerous [localities](#) across most of their known [range](#).

How is the appropriate subcriterion (B3a, B3b or B3c) determined?

The [KBA Standard](#) states that Criterion B3a is applicable to [taxonomic groups](#) for which the global median [range](#) size is <25,000 km², while B3b is applicable to [taxonomic groups](#) with a global median [range](#) size ≥25,000 km² (IUCN, 2016, p. 19). For [taxonomic groups](#) that do not have a representative sample mapped globally

⁸ Currently Actinopterygii (B3b), Amphibia (B3a), Aves (B3b), Cephalaspidomorphi (B3b), Ceratophyllales (B3b), Chondrichthyes (B3b), Mammalia (B3b), Myxini (B3b), Odonata (B3a), Proteales (B3a) and Sarcopterygii (B3b).

using a consistent methodology, the default is subcriterion B3a if all (or nearly all) **ecoregion**-restricted species can be identified for an **ecoregion**, or subcriterion B3c otherwise.

Subcriterion B3c was developed to enable identification of **geographically restricted assemblages** without reference to **ecoregions** or **bioregions**. For several **taxonomic groups**, including many plants, fungi, invertebrates and fishes, adequate sampling data are available to identify areas of high relative density or abundance for some species while the **range** outside these areas is poorly defined. Given such data limitations, it will often be impossible to apply B3a or B3b to these **taxonomic groups** because it is a requirement of B3a and B3b that the number of species within a **taxonomic group** restricted to a particular **ecoregion/bioregion** is known. **KBA NCGs** and **KBA Proposers** are advised to consult with their **KBA RFP** before applying subcriterion B3c.

Is it possible to apply different subcriteria to the same taxonomic group in different regions?

For each **taxonomic group**, B3c should only be applied where it is not possible to apply B3a or B3b because the number of species restricted to a particular **ecoregion** or **bioregion** cannot be estimated. Thus, it is possible to apply B3a and B3c or B3b and B3c to the same **taxonomic group** in different regions, depending on the level of knowledge. Note, however, that B3c applies to a species' entire **range** (not its **range** within a specific **ecoregion** or **bioregion**) and the most important occupied habitat must be assessed across all regions.

In contrast, it is not possible to apply B3a and B3b to the same **taxonomic group** in different regions because B3a is applicable to **taxonomic groups** with global median **range** size <25,000km², while B3b is applicable to **taxonomic groups** with global median **range** size ≥25,000 km² (IUCN, 2016, p. 19).

How are ecoregion-restricted assemblages identified under subcriterion B3a?

The **KBA Standard** defines **ecoregions** as: A “relatively large unit of land (or water) containing a distinct assemblage of natural communities and species with boundaries that approximate the original extent of natural communities prior to major land-use change” (Olson et al., 2001).

Ideally, **ecoregion**- or **bioregion**-restricted species would simply be identified by overlaying **ecoregion** or **bioregion** templates on species' **range** maps. But this approach is limited due to a combination of the relatively coarse spatial resolution of

ecoregion and **bioregion** templates and the relatively high endemism requirement of 95%, especially when based on **range**. **Range** maps typically include areas that are not used by the species, so this approach may fail to identify a number of species that are genuinely **ecoregion**- or **bioregion**-restricted. Therefore, it is important to allow modification of lists of **ecoregion**- and **bioregion**-restricted species based on expert knowledge, rather than relying solely on spatial overlays.

The **KBA Secretariat** generates preliminary lists of **ecoregion**-restricted species by overlaying **ecoregion templates** (Appendix V) on **range** maps or validated **ESH** maps for all species with an **IUCN Red List** range map. If the **KBA NCG** or other local experts hold good information on the distribution of a taxonomic group within an **ecoregion**, then the list of **ecoregion**-restricted species based on the spatial overlay may be replaced by a list identified by the **KBA NCG** or other local experts. If an **ecoregion** straddles national boundaries, agreement between **KBA NCGs** or local experts will be needed in advance of submitting an expert-derived list of **ecoregion**-restricted species. Please see Appendix V for **ecoregion** templates for terrestrial, freshwater and marine systems.

Lists of **ecoregion**-restricted species are provided on the **KBA website (Tools page)**.

How are bioregion-restricted assemblages identified under subcriterion B3b?

The **KBA Standard** defines **bioregions** as: Major regional terrestrial and aquatic habitat types distinguished by their climate, flora and fauna, such as the combination of terrestrial biomes and biogeographic realms (Olson et al., 2001) or marine provinces (Spalding et al., 2007, Spalding et al., 2012).

The process of developing lists of **bioregion**-restricted species parallels that described above for **ecoregion**-restricted species, except that the **KBA Secretariat** only generates lists for relevant taxonomic groups that have been comprehensively assessed (e.g., mammals, birds).

KBA NCGs and **KBA Proposers** interested in developing a list of **bioregion**-restricted species for other **taxonomic groups** are asked to contact their **KBA RFP** first to avoid duplication of effort. **Bioregion** templates for terrestrial, freshwater and marine systems are currently being evaluated and will be provided in Appendix V in due course.

Lists of **bioregion**-restricted species will be provided on the **KBA website (Tools page)** in due course.

Can KBA Criterion B3 be applied to migratory species?

In the case of migratory species, Criterion B3 may be applied separately to each spatially segregated **life-cycle process**. For example, a migratory species may be **ecoregion-** or **bioregion-**restricted in its breeding **range**, but not in its non-breeding **range**, in which case it can only trigger a **KBA** under Criterion B3 in its breeding **range**. (See Appendix III for details on how **range** is assessed for migratory species.)

Can geographically restricted assemblages be identified across ecoregion or bioregion boundaries under B3a or B3b?

Criterion B3 applies to individual **ecoregions** or **bioregions**. **Geographically restricted assemblages** cannot be combined across **ecoregion** or **bioregion** boundaries to meet the **thresholds** (see also Section 2.6.1).

How are geographically restricted assemblages identified under subcriterion B3c?

Sites qualifying under subcriterion B3c hold geographically concentrated **assemblages** of species within a **taxonomic group**, but the component species do not need to be **geographically restricted**, unlike B3a and B3b. Data on the relative density or relative abundance of **mature individuals** are needed at many **localities** encompassing most of the species' known **range**, along with the expectation that unsampled areas are unlikely to hold relatively high densities. For each **taxonomic group** assessed against subcriterion B3c in a region, the first step in identifying **geographically restricted assemblages** is to identify species within the **taxonomic group** that have been surveyed using systematic and quantitative methods at numerous **localities** across most of their known **range**, including all suspected high-density areas.

2.7.2 For each taxonomic group, check the relevant species threshold and the population-size threshold.

A **site** qualifies as a **KBA** under Criterion B3 because it **regularly** holds one or more of the following (IUCN, 2016, p. 19, with minor edits for clarification):

- a) $\geq 0.5\%$ of the **global population size** of each of a number of **ecoregion-**restricted species within a **taxonomic group**, determined as either ≥ 5 species OR 10% of the species restricted to the **ecoregion**, whichever is larger;
- b) ≥ 5 **reproductive units** of ≥ 5 **bioregion-**restricted species OR ≥ 5 **reproductive units** of 30% of the **bioregion-**restricted species known from the country, whichever is larger, within a **taxonomic group**;
- c) Part of the **globally** most important 5% of occupied habitat for each of ≥ 5 species within a **taxonomic group**.

Subcriterion B3a:

For each combination of **ecoregion** and **taxonomic group** that has been comprehensively assessed for the **IUCN Red List** or previously assessed for Criterion B3a, the number of **ecoregion**-restricted species will be provided on the **KBA website (Tools page)**, together with the number of **ecoregion**-restricted species that must co-occur at a **site** to trigger a **KBA** under Criterion B3a.

For other **taxonomic groups**, **KBA Proposers** should consult with their **KBA RFP** before proceeding. In many cases, it will be possible to determine the species **threshold** based on an estimate of the number of species restricted to the **ecoregion**. An exact number may not be required. If the number is less than 60, then the **threshold** is simply 5 **ecoregion**-restricted species. Conversely, if the number is greater than or equal to 60 then the species **threshold** is 10% of the number of species restricted to the **ecoregion**.

Subcriterion B3b:

For each combination of **bioregion** and **taxonomic group**, **KBA Proposers** should estimate the number of species within the **taxonomic group** that are both restricted to the **bioregion** and known from the country (i.e. the number known from the country is per **bioregion** not for a combination of **bioregions**). An exact number may not be required. If the number is less than 20, then the **threshold** is simply 5 **bioregion**-restricted species. Conversely, if the number is greater than or equal to 20 then the species **threshold** is 30% of the number of species restricted to the **bioregion** that are known from the country.

“Known from the country” requires regular occurrence, and cannot be based on **vagrants**. For marine species “known from the country” refers to the Exclusive Economic Zone (EEZ).

Subcriterion B3c:

Relevant **thresholds** are fixed for subcriterion B3c. Any polygon or grid cell that ranks in the top 5% in terms of relative densities or abundance for each of 5 or more well-sampled species within the **taxonomic group** may form the basis for identifying and delineating a **KBA** under subcriterion B3c.

2.7.3 For each potential trigger species, identify assessment parameters for which reliable global and local level data are available, and estimate these parameters at the global and site level for all sites where the species may meet the relevant population-size threshold.

Subcriterion B3a:

For each proposed **site**, first assess whether the **threshold** number of **ecoregion**-restricted species co-occurs at the **site**. For each potential **trigger** species, review the available data at **global** and local levels and decide which assessment parameters to use, then estimate **global** and **site**-level values for those parameters. Under subcriterion B3a, the proportion of the **global population size** can be observed or inferred through any of the following:

- (i) number of **mature individuals**,
- (ii) **area of occupancy**,
- (iii) **extent of suitable habitat**,
- (iv) **range**,
- (v) number of **localities**.

See Section 3.1 for guidelines on selecting among assessment parameters.

Subcriterion B3b:

For each proposed **site**, first assess whether the **threshold** number of **bioregion**-restricted species co-occurs at the **site**. For subcriterion B3b, the **threshold** is defined in terms of **reproductive units** (see Section 3.3). Note that the 5 **reproductive units threshold** applies regardless of whether the species **threshold** is 5 **bioregion**-restricted species or 30% of **bioregion**-restricted species known from the country. (This is a clarification of the text in the **KBA Standard**; IUCN, 2016, p. 19.)

Subcriterion B3c:

Under subcriterion B3c, “the **globally** most important occupied habitat” can be observed or inferred through the following:

- (i) density of **mature individuals**,
- (ii) relative abundance of **mature individuals**.

Note that (i) may refer to relative densities as well as absolute densities.

Subcriterion B3c is designed to identify **sites** that are disproportionately important within the set of **sites** where species within a **taxonomic group** are known to occur (e.g., **sites** with exceptionally high productivity). Subcriterion B3c does not target **geographically restricted biodiversity** — individual **geographically restricted** species

and co-occurring **geographically restricted** species are the focus of Criteria B1 and B2 respectively.

Analysis of relative densities or abundance should be based on a set of theoretical **sites** of similar size. Where possible, it is recommended that **KBA Proposers** use grid cells or polygons with a spatial resolution close to the average size of **manageable** units within the region of interest. Grid cells may be better suited to species with continuous distributions, especially in areas with few existing **sites**; whereas other polygons may be better suited to species with patchy distributions. If polygons vary in size, then relative densities should be used, rather than abundance. The grid or set of polygons should extend across most of the known **ranges** of each of the species in the analysis, including all suspected high density areas.

For each species, relative density or abundance estimates should be available for a large number of cells or polygons (generally greater than 100) — species recorded at fewer than 20 cells or polygons should be excluded. The relative density or abundance of each species included in the analysis is tabulated for each cell or polygon. If sampling has been conducted at a finer resolution than the cells or polygons used in this analysis, then the average relative density or abundance should be estimated for each cell or polygon. For highly mobile species, sampling data should be averaged over multiple sampling seasons.

For each species, cells or polygons are ranked from the most important (i.e. highest relative density or abundance) to least important; ranks are then divided by the number of cells or polygons with the species present. For example, if a species occurs at 50 **sites**, the proportional ranking for the three most important **sites** is 1/50, 2/50, and 3/50 (i.e. 2%, 4%, 6%), and therefore the two most important **sites** are included in the most important 5% of habitat for the species. A cell-by-species or polygon-by-species matrix is thereby constructed with cells or polygons in the most important 5% of habitat for each species identified. For each cell or polygon, it is then possible to count the number of species for which the cell or polygon is in the most important 5% of habitat. The ≥ 5 species **threshold** is then applied to identify cells or polygons that could form the basis for delineating a **KBA**.

2.7.4 Assess whether each potential trigger species meets the relevant population-size threshold at each existing/potential site.

Subcriterion B3a:

For each potential **trigger** species under subcriterion B3a, **KBA Proposers** should calculate the proportion of the **global population size** that **regularly** occurs at each **site**

based on the estimated [global](#) and [site](#)-level values for each assessment parameter, and then compare that to the 0.5% [population-size threshold](#) for subcriterion B3a.

[KBA Proposers](#) should then compare the number of species that meet the [population-size threshold](#) at the [site](#) to the [species threshold](#) for subcriterion B3a, given the number of species in the [taxonomic group](#) restricted to the [ecoregion](#).

These calculations will be checked in the [WDKBA](#) when it is fully functional.

Subcriterion B3b:

For each potential [trigger](#) species under subcriterion B3b, [KBA Proposers](#) should assess whether the number of [reproductive units](#) that [regularly](#) occurs at the [site](#) meets or exceeds the 5 [reproductive-units threshold](#).

[KBA Proposers](#) should then compare the number of species that meet the [reproductive-units threshold](#) at the [site](#) to the [species threshold](#) for subcriterion B3b, given the number of species in the [taxonomic group](#) restricted to the [bioregion](#) and known from the country.

These calculations will be checked in the [WDKBA](#) when it is fully functional.

Subcriterion B3c:

For subcriterion B3c, see Section 2.7.3 above.

2.7.5 Confirm the presence of each potential trigger species that meets the relevant population-size threshold at each proposed site.

The final step in assessing a [site](#) against [KBA](#) Criterion B3 is to confirm the presence of each potential [trigger](#) species at the [site](#) by reviewing recent data, interviewing [biodiversity](#) knowledge-holders, or conducting new field surveys.

For subcriterion B3b, the species must be [regularly](#) present in numbers that meet or exceed the relevant [reproductive-units threshold](#) (see Section 3.3).

While there is no explicit [reproductive-units threshold](#) for subcriteria B3a and B3c, numbers and densities of [mature individuals](#) should be sufficient to support reproduction at [sites](#) within the breeding [range](#). [KBA Proposers](#) are encouraged to confirm the presence of potential [trigger](#) species at the [site](#) in terms of [reproductive units](#), where this information is readily available, using the 5 [reproductive units threshold](#) for Criterion B3b, for example.

2.7.6 Refine ecological boundaries, if necessary, to yield practical KBA boundaries.

KBA delineation is not complete until ecological boundaries have been evaluated and refined, if necessary, to yield a **manageable site** or **sites** (see Section 7.3 for guidelines on delineation).

2.7.7 Compile required and recommended documentation under Criterion B3.

See the **KBA Proposal Process guidance** for required and recommended documentation for Criterion B3.

2.8 Applying Criterion D1 to identify KBAs for demographic aggregations

2.8.1 Identify species that aggregate at specific sites and may trigger Criterion D1.

Criterion D1 is triggered by demographic **aggregations** of species, typically occurring during a specific **life-cycle process**. When applying Criterion D1, **KBA Proposers** first need to confirm whether the population at the **site** represents a demographic **aggregation**.

The **trigger** species must aggregate at the **site** — a species cannot trigger a KBA under Criterion D1 at sites where it does not aggregate, even if it is generally considered congregatory. Many congregatory species aggregate for some **life-cycle processes**, but disperse widely for others. For example, many shorebird species (family Scolopacidae), aggregate for specific **life-cycle processes** (e.g., during migration or to over-winter) and are more widely dispersed at lower densities during other seasons. Albatross and petrel species typically aggregate in breeding colonies, but many species disperse widely at sea, even though foraging **aggregations** may occur at specific oceanographic **sites** such as seamounts⁹. A few species, such as the Lesser Flamingo (*Phoeniconaias minor*), are aggregated through most or all of their life-cycles. Criterion D1 may be applied to species that aggregate for some or all of their life-cycle (IUCN, 2016, p. 22) if they form an **aggregation** at the **site**.

Sites that support $\geq 1\%$ of the **global population size** of a species but where the species is not aggregated do not qualify as **KBAs** under Criterion D1. For example, almost the entire global population of Kirtland's Warbler (*Setophaga kirtlandii*) breeds in a very limited area in north and central Michigan (USA), but does not aggregate to breed, so does not trigger D1. (It could, however, trigger **KBAs** under Criterion B1 for any **site** that **regularly** holds $\geq 10\%$ of the **global population size** and ≥ 10 **reproductive units**.)

⁹ Note that this differs from the comment in the **KBA Standard** that albatrosses and petrels remain aggregated throughout most or all of their life cycles as they move between sites (IUCN 2016, p. 22).

Information indicating that the species forms an **aggregation** at the **site** must be included in **KBA** proposals under Criterion D1. Relevant information will most likely be found through a literature search or expert knowledge.

How are demographic aggregations defined for the purposes of applying KBA Criterion D1?

An **aggregation** is defined in the **KBA Standard** as: “A **geographically restricted** clustering of individuals that typically occurs during a specific **life-cycle process** such as breeding, feeding or migration. This clustering is indicated by highly localised relative abundance, two or more orders of magnitude larger than the species’ average recorded numbers or densities at other stages during its life-cycle.” (IUCN, 2016, p. 11)

The **KBA Standard** refers to a difference in relative abundance of two or more orders of magnitude, but this is advisory rather than required. Other types of information indicating a “clustering of individuals” and “highly localised relative abundance” may be used to support **KBA** proposals under Criterion D1. For example, nearest-neighbour distances measured in body lengths have been used to describe **aggregations** in a wide range of species, including fish spawning **aggregations**, dolphin schools, waterbird feeding flocks, and herds of foraging ungulates. A characteristic of **aggregations** is that the concentration of a **significant** proportion of a species’ **global population size** in space and time (i.e. at a specific location, either simultaneously or over a short period of time) increases the species’ vulnerability to exploitation or other threats.

In some cases, an **aggregation** occupies a relatively small area in a larger **site** because the **aggregation** moves unpredictably within a broader predictable space or because **site** delineation accommodates additional **biodiversity elements** or **manageability** considerations. Where this is the case, **KBA Proposers** are asked to note this in the **KBA** proposal.

Can foraging areas for species that aggregate to breed qualify as KBAs under Criterion D1?

Many congregatory species aggregate to breed, but disperse widely while foraging (e.g., some seabird and pinniped species). For such species, a **site** that holds a breeding colony or rookery of 1% or more of the **global population size** would be expected to meet the **aggregation** requirement and qualify under D1a. By extension, a **site** that includes a colony or rookery and associated marine area (perhaps encompassing an

important staging or foraging area) would also be expected to meet the D1 **aggregation** requirement because it includes the colony or rookery as well as staging or foraging **aggregation** areas. For some species, a separate foraging area might meet the **aggregation** requirement in its own right — for example, the highly social Guanay Cormorant (*Leucocarbo bougainvilliorum*) forages in large dense foraging flocks, especially at locations where oceanographic processes **predictably** concentrate prey near the surface. A **site** that **predictably** holds dense foraging flocks would meet the **aggregation** requirement and qualify under D1a if the population-size threshold is also met. In contrast, a separate foraging area would not meet the D1 **aggregation** requirement if the species does not **predictably** form dense foraging flocks at the **site**, even if the species aggregates elsewhere in its **range** in the same season (e.g., many gadfly petrel species, genus *Pterodroma*).

How are migratory stop-over or bottleneck sites identified?

Along migration routes, **KBAs** should be identified at key stop-over or bottleneck **sites**, as stated in the **KBA Standard** (IUCN, 2016, p. 22), rather than over entire migration corridors. Distinguishing stop-over or bottleneck **sites** may be challenging, especially for species that do not fly. Individuals are expected to accumulate as the movement process slows, so stop-over and bottleneck **sites** may be distinguished using survey data by higher than average densities along a migration corridor. In animal tracking datasets, stop-over **sites** may be identified by a switch from fast directed movements to slower more tortuous movements.

Can Criterion D1 be applied to resident species or populations?

The **KBA Standard** states that “Criterion D1 is not meant to identify **sites** that hold all key stages of a species’ life-cycle; those **sites** may be triggered by criteria A1, B1, B2 or B3.” Thus, Criterion D1 is not generally intended to apply to resident species or the resident components of partially migratory species, where they can be discerned, although it may be triggered by resident species that aggregate in specific areas within their **range** for specific **life-cycle processes** (e.g., at lekking areas or in spawning areas).

Can KBA Criterion D1 be applied to aggregations of juveniles or other life stages?

KBA Criterion D1 cannot be triggered by **aggregations** of juveniles or other life stages as the **threshold** is defined in terms of **mature individuals** only.

2.8.2 Check the relevant subcriterion and threshold for each potential trigger species.

A **site** qualifies as a **KBA** under Criterion D1 because it **predictably** holds one or more of the following:

- a) An **aggregation** representing $\geq 1\%$ of the **global population size** of a species, over a season, and during one or more key stages of its life cycle;
- b) A number of **mature individuals** that ranks the **site** among the largest 10 **aggregations** known for the species.

Criterion D1 is intended to apply to single large **aggregations** rather than clusters of smaller **aggregations**, as indicated in the wording of the **thresholds**.

What is meant by “predictably holds”?

For Criterion D1, a **site predictably** holds a species if the species is known to have occurred at the **site** in at least two thirds of the years for which adequate data are available for the relevant season (e.g., the breeding season in the case of a breeding **aggregation**); the total number of years considered should not be fewer than three. For example, a **site** would qualify if a species occurs there at **threshold** numbers during the breeding season in 2 out of 3 years or 7 out of 10 years. This is consistent with the definition of “**regularly**” in the application of Ramsar Criteria 5 and 6 (Ramsar, 2018).

What is meant by life-history stage in the threshold for D1a?

The term “**life-history stage**” here is intended to be synonymous with **life-cycle process** (e.g., breeding, feeding, migration) and does not refer to developmental stage (e.g., pup, juvenile, adult).

What does “over a season” mean in the threshold for D1a?

“Over a season, and during one or more key stages of its life cycle” refers to a specific period of the year when some or all members of a population **predictably** aggregate to perform some **life-cycle process(es)**, such as breeding, moulting, or over-wintering.

Under subcriterion D1a, the **threshold population size** may be met cumulatively “over a season”. This is especially relevant to stop-over or bottleneck **sites** along migration corridors — the **threshold** number of **mature individuals** may not occur at the **site** simultaneously; instead, the **threshold** may be met over a relatively short period of time during the migration season, in a relatively small space with individuals clustered together at highly localised relative abundance.

When is subcriterion D1b applicable?

Subcriterion D1b is only applicable if there are insufficient data to apply subcriterion D1a. For example, even if a **site** ranks among the largest 10 **aggregations** known for

the species, it cannot qualify under Criterion D if it is known to hold <1% of the **global population size** of the species.

For a few species, it may be possible to infer that the D1b threshold is met, even if data are only available in terms of **localities**. For example, if **mature individuals** of a species is only known to aggregate at 10 or fewer **localities** throughout its **range**, then it can be inferred that these **localities** are among the largest 10 **aggregations** of the species in terms of **mature individuals**.

Can subcriterion D1b be applied separately to aggregations for specific functions?

The D1b **threshold** (i.e. the largest 10 **aggregations** known for the species) applies across all **life-cycle processes** rather than separately for specific processes (e.g., breeding or feeding). Thus, if a species forms **aggregations** at one time of year for breeding and **aggregations** at another time of year for feeding, only the ten largest **aggregations** across both seasons would qualify.

2.8.3 For D1, the only assessment parameter is number of mature individuals; estimate this parameter at the global and site level for all sites where the species may meet the relevant threshold.

For Criterion D1, the proportion of the **global population size** at a **site** can be observed or inferred through the following:

- (i) number of **mature individuals**.

Note that the proportion of the **global population size predictably** held at a **site** cannot be inferred using area-based parameters or **localities** under Criterion D1. For some species, however, numbers of individuals in large **aggregations** are extremely hard to estimate, but the densities of individuals in **aggregations** of the same type may be relatively consistent (e.g., some seabird species nest pecking-distance apart). In this case, the size (i.e. area or volume) of the **aggregation** may be used to infer whether a **site** ranks among the largest 10 **aggregations** known for the species under Criterion D1b.

Individual mark-recapture data can be used to provide reliable estimates of **population size** at stop-over or bottleneck **sites** with high turnover (Ramsar, 2018).

2.8.4 Assess whether each potential trigger species meets the relevant threshold at each existing/potential site.

For each potential **trigger** species under subcriterion D1a, **KBA Proposers** should calculate the proportion of the **global population size** that **predictably** occurs at each **site** based on the estimated **global** and **site**-level values for each assessment parameter,

and then compare that to the 1% [population-size threshold](#) for subcriterion D1a. This calculation will be checked in the [WDKBA](#) when it is fully functional.

For subcriterion D1b, [KBA Proposers](#) should estimate the [aggregation](#) size at [sites](#) that host the largest [aggregations](#) of the species [globally](#), with the number of [sites](#) sufficient to demonstrate clearly that any proposed [KBAs](#) rank among the largest 10 [aggregations](#).

2.8.5 Confirm the seasonal presence of each potential trigger species that meets the relevant threshold at each proposed site.

The final step in assessing a [site](#) against [KBA](#) Criterion D1 is to confirm the seasonal presence of each potential [trigger](#) species at each proposed [site](#) by reviewing recent data, interviewing local [biodiversity](#) knowledge-holders, or conducting new field surveys.

What is necessary to confirm seasonal presence at a site for Criterion D1 given that there are no reproductive-units thresholds?

While there is no explicit [reproductive-units threshold](#) for Criterion D1, [KBA Proposers](#) are encouraged to confirm the presence of potential [trigger](#) species at the [site](#) in terms of [reproductive units](#) (see Section 3.3), where appropriate (using the 10 [reproductive-units threshold](#) for Criterion B1, for example). This is most relevant for spawning [aggregations](#) that are severely depleted but trigger Criterion D1b.

2.8.6 Refine ecological boundaries, if necessary, to yield practical KBA boundaries.

[KBA](#) delineation is not complete until ecological boundaries have been evaluated and refined, if necessary, to yield a [manageable site](#) or [sites](#) (see Section 7.3 for guidelines on delineation).

2.8.7 Compile required and recommended documentation under Criterion D1.

See the [KBA Proposal Process guidance](#) for required and recommended documentation for Criterion D1.

2.9 Applying Criterion D2 to identify KBAs for ecological refugia

2.9.1 Identify species that may trigger Criterion D2.

Criterion D2 is triggered by species that become concentrated during periods of [environmental stress](#).

2.9.2 The D2 threshold is 10% for all species.

A **site** qualifies as a **KBA** under Criterion D2 because it supports $\geq 10\%$ of the **global population size** of one or more species during periods of **environmental stress**, for which historical evidence shows that it has served as an ecological refuge in the past and for which there is evidence to suggest it would continue to do so in the foreseeable future.

Information describing the type of **environmental stress** that has led the proposed trigger species to seek refuge at the **site** in significant numbers in the past, together with evidence suggesting that the **site** would continue to serve this role in the future must be included in **KBA** proposals under Criterion D2. Relevant information will most likely be found through a literature search or expert knowledge.

2.9.3 For D2, the only assessment parameter is number of mature individuals; estimate this parameter at the global and site level for all sites where the species may meet the 10% threshold.

For Criterion D2, the proportion of the **global population size** at a **site** can be observed or inferred through the following:

- (i) number of **mature individuals**.

For each potential **trigger** species, **KBA Proposers** should estimate the **global population size** and numbers of **mature individuals** that have occurred at the proposed **site** during periods of **environmental stress**.

2.9.4 Assess whether each potential trigger species meets the 10% threshold at each existing/potential site.

For each potential **trigger** species under Criterion D2, **KBA Proposers** should calculate the proportion of the **global population size** that has occurred at each **site** during periods of **environmental stress**, based on the estimated **global** and **site-level** values, and then compare that to the 10% **population-size threshold** for Criterion D2. Note that the **global population size** may be reduced during periods of stress. Note also that the proportion of the **global population size** at a **site** cannot be inferred using area-based parameters or **localities** under D2.

The term “**predictably**” is not used in Criterion D2, but consistent with D1 and D3, a **site** may be considered to hold a species during periods of **environmental stress** if the species is known to have occurred at the **site** in at least two thirds of the periods of **environmental stress** for which adequate data are available. (There is no minimum

number of periods of [environmental stress](#) given here, as these are assumed to be rare events.)

2.9.5 Confirm that conditions at each proposed site remain suitable for supporting each potential trigger species during periods of environmental stress.

In addition to historical evidence showing that the [site](#) has served as an ecological refuge in the past, [KBA Proposers](#) should review recent data, interview local [biodiversity](#) knowledge-holders or conduct new field surveys to evaluate evidence that it would continue to do so in the foreseeable future.

2.9.6 Refine ecological boundaries, if necessary to yield practical KBA boundaries.

[KBA](#) delineation is not complete until ecological boundaries have been evaluated and refined, if necessary, to yield a [manageable site](#) or [sites](#) (see Section 7.3 for guidelines on delineation).

2.9.7 Compile required and recommended documentation under Criterion D2.

See the [KBA Proposal Process guidance](#) for required and recommended documentation for Criterion D2.

[2.10 Applying Criterion D3 to identify KBAs for recruitment sources](#)

2.10.1 Identify species that may trigger Criterion D3.

Compile a list of species that may trigger Criterion D3 (i.e. species whose ecologies are characterised by [recruitment source sites](#) that produce propagules, larvae or juveniles that make a large contribution to the recruitment of [mature individuals](#) elsewhere). Any species with these characteristics, including many plants, fungi, marine invertebrates and fishes, can trigger Criterion D3. [Recruitment sources](#) include [sites](#) where plants or fungi produce a large number of seeds or spores that have a high probability of dispersing, and germinating and surviving to maturity elsewhere; [sites](#) where adults deposit a large number of eggs that have a high probability of producing larvae that survive to maturity and disperse elsewhere; and nursery [sites](#) where large numbers of larvae settle and have a high probability of growing into juveniles that survive to maturity and disperse elsewhere. Relevant information will most likely be found through a literature search and/or expert knowledge.

2.10.2 The D3 threshold is 10% for all species.

A **site** qualifies as a **KBA** under Criterion D3 because it **predictably** produces propagules, larvae, or juveniles that maintain $\geq 10\%$ of the **global population size** of a species.

2.10.3 For D3, the only assessment parameter is number of mature individuals; estimate this parameter at the global and site level for all sites where the contribution to recruitment may meet the 10% threshold.

For Criterion D3, the proportion of the **global population size** can be observed or inferred through the following:

- (i) number of **mature individuals**.

A **significant** proportion of the **global population size** of a species may be produced at **sites** identified under Criterion D3 even though there may be only a few **mature individuals** at the **site** at any given time. Hence, the **threshold** is based on the **global population size** of **mature individuals** produced by the **site**, rather than the number of immature individuals within the **site**. **KBA Proposers** should estimate the **global population size** and the number of **mature individuals** that are produced by each proposed **site**. Note that the proportion of the **global population size** produced by a **site** cannot be inferred using area-based parameters or **localities** under D3.

How can the number of mature individuals produced by a site be estimated?

Estimating the proportion of the **global population size** of **mature individuals** that is produced by a **site** will often be challenging.

For most species, it is not feasible to tag or track propagules, larvae, or juveniles from recruitment to maturity. Exceptions may include anadromous fish species with high site-fidelity (e.g., salmon), or species that produce large juveniles (e.g., sharks and rays). For some species (e.g., corals), genetic markers have been used to identify **recruitment sources**.

Recruitment models that include the transport or dispersal of propagules, larvae, or juveniles from **recruitment sources** to final settlement **sites** have also been developed for some species (e.g., fungi, plants, corals, benthic invertebrates), but are often complex and difficult to validate.

Identification of **recruitment sources** may therefore be based on the simplifying assumption that survival from proposed **recruitment source** habitat to maturity is uniform, unless reliable data or models are available to quantify an alternative distribution. Hence, in most cases, it will be sufficient to estimate the relative density

of propagules, larvae, juveniles and use this information to identify **recruitment sources** that produce $\geq 10\%$ of propagules, larvae, or juveniles, under the assumption that these **recruitment sources** also produce $\geq 10\%$ of **mature individuals**. This can be achieved through direct sampling throughout the **range** or, more likely, a combination of sampling and spatial density modelling (see Appendix III).

What is meant by “predictably produces”?

For Criterion D3, a **site predictably** produces propagules, larvae, or juveniles that maintain $\geq 10\%$ of the **global population size** of a species if it produces them in at least two thirds of the recruitment cycles for which adequate data are available; the total number of recruitment cycles considered should not be fewer than three.

2.10.4 For each potential trigger species, assess whether the contribution to recruitment meets the 10% threshold at each existing/potential site.

For each potential **trigger** species under Criterion D3, **KBA Proposers** should calculate the proportion of the **global population size** that is **predictably** produced by each **site** based on the estimated **global** and **site-level** values for each assessment parameter, and then compare that to the 10% **population-size threshold** for Criterion D3. This calculation will be checked in the **WDKBA** when it is fully functional.

2.10.5 Confirm that each proposed site produces recruits in numbers consistent with the 10% threshold.

Review recent data, interview local **biodiversity** knowledge-holders, or conduct new field surveys to confirm the presence of propagules, larvae or juveniles at the site and verify that each proposed **site** produces recruits in numbers consistent with the **population-size threshold** for each proposed **trigger** species.

2.10.6 Refine ecological boundaries, if necessary, to yield practical KBA boundaries.

KBA delineation is not complete until ecological boundaries have been evaluated and refined, if necessary, to yield a **manageable site** or **sites** (see Section 7.3 for guidelines on delineation).

2.10.7 Compile required and recommended documentation under Criterion D3.

See the **KBA Proposal Process guidance** for required and recommended documentation for Criterion D3.

3. Assessment parameters for species-based criteria (A1, B1-3, D1-3 and E)

3.1 Selecting assessment parameters

Which assessment parameters provide the best indication of the proportion of the global population size at a site?

Under KBA Criteria A1, B1-2 and B3a, the proportion of the **global population size** at a **site** can be observed or inferred through any of the following:

- (i) number of **mature individuals**,
- (ii) **area of occupancy**,
- (iii) **extent of suitable habitat**,
- (iv) **range**,
- (v) number of **localities**,
- (vi) **distinct genetic diversity** (except for Criterion B3a).

KBA NCGs and KBA Proposers are responsible for ensuring that KBA identification is based on the best available data for each species. The rest of this section provides an overview of what is meant by “best” and “available” in this context. In brief, the “best” parameter provides a measure of the proportion of the **global population size** at a **site** that is most appropriate to the ecology of the species; while an “available” parameter has already been estimated (or can be estimated) consistently at both **global** and **site** levels, is complete, recent, reliable and documented. (**Distinct genetic diversity** measures the proportion of genetic diversity rather than the proportion of **global population size** at a **site** and is excluded from this overview.)

In principle, the number of **mature individuals** provides the best (most direct) measure of the proportion of the **global population size** at a **site** (Fig. 3.1.1). However, in some species, the number of **mature individuals** fluctuates significantly among years or within seasons at the **global** and/or **site** scale, such that the proportion of **mature individuals** held at the **site** often switches above-and-below the **threshold** from one year to the next. In that context, one or more of the area-based assessment parameters or **localities** (i.e. ii-iv) may provide a better (less direct but more stable) indicator of the proportion of the **global population size** *regularly* held at a **site**. **Mature individuals** may still be used to assess the proportion of the **global population size** *predictably* held at a **site** based on the two-thirds rule (see 9.3.2 on dealing with ecological variation).

Area-based assessment parameters should be used cautiously, as species are generally unevenly distributed across their **range**, **ESH** or even **AOO**. Estimating numbers of **mature individuals** should be prioritised for species that occur at highly variable densities within their **range**, **ESH** or **AOO**, or that are unevenly distributed among **localities**. Area-based assessment parameters and **localities** should not be used for species on migration or moving nomadically or for species with dynamic habitat and consequently distribution patterns that fluctuate significantly among years or within seasons, or for **sites** that are primarily used during migration or by nomadic populations (Fig. 3.1.1).

Species that exhibit significant fluctuations in both **population size** and distribution may depend primarily on conservation actions at the landscape or seascape scale rather than the **site** scale of **KBAs**.

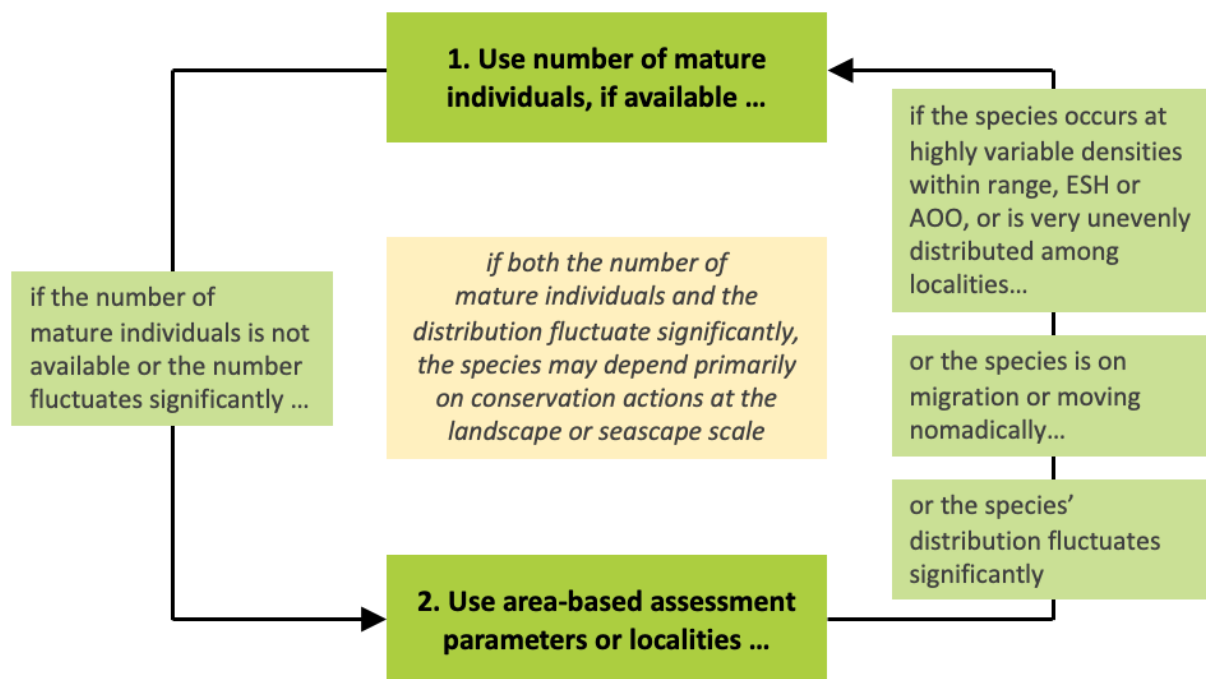


Figure 3.1.1 Selecting between number of mature individuals and area-based assessment parameters or localities. *Source: Compiled by the KBA SAC.*

An overview of area-based parameters and **localities** is provided in Section 3.4. As **range** is refined to **ESH** and then to **AOO**, the area covered generally decreases, leading to a better representation of the actual distribution of the species. Hence, **AOO** generally provides the best approximation of the proportion of a species' **global** population at a **site**, followed by **ESH**, then **range** or **localities**, except under the circumstances set out in Figure 3.1.2. For example, **KBA Proposers** are encouraged to compile data on **AOO** for species that occur patchily within mapped habitat, whether

naturally or because they have been extirpated from suitable habitat; but ESH should be selected over AOO if it is not possible to distinguish occupied habitat. When in doubt, KBA Proposers may choose to assess the proportion of species' global population at a site using several area-based parameters to develop multiple lines of evidence, although it is recognised that there will often be insufficient data to do this.

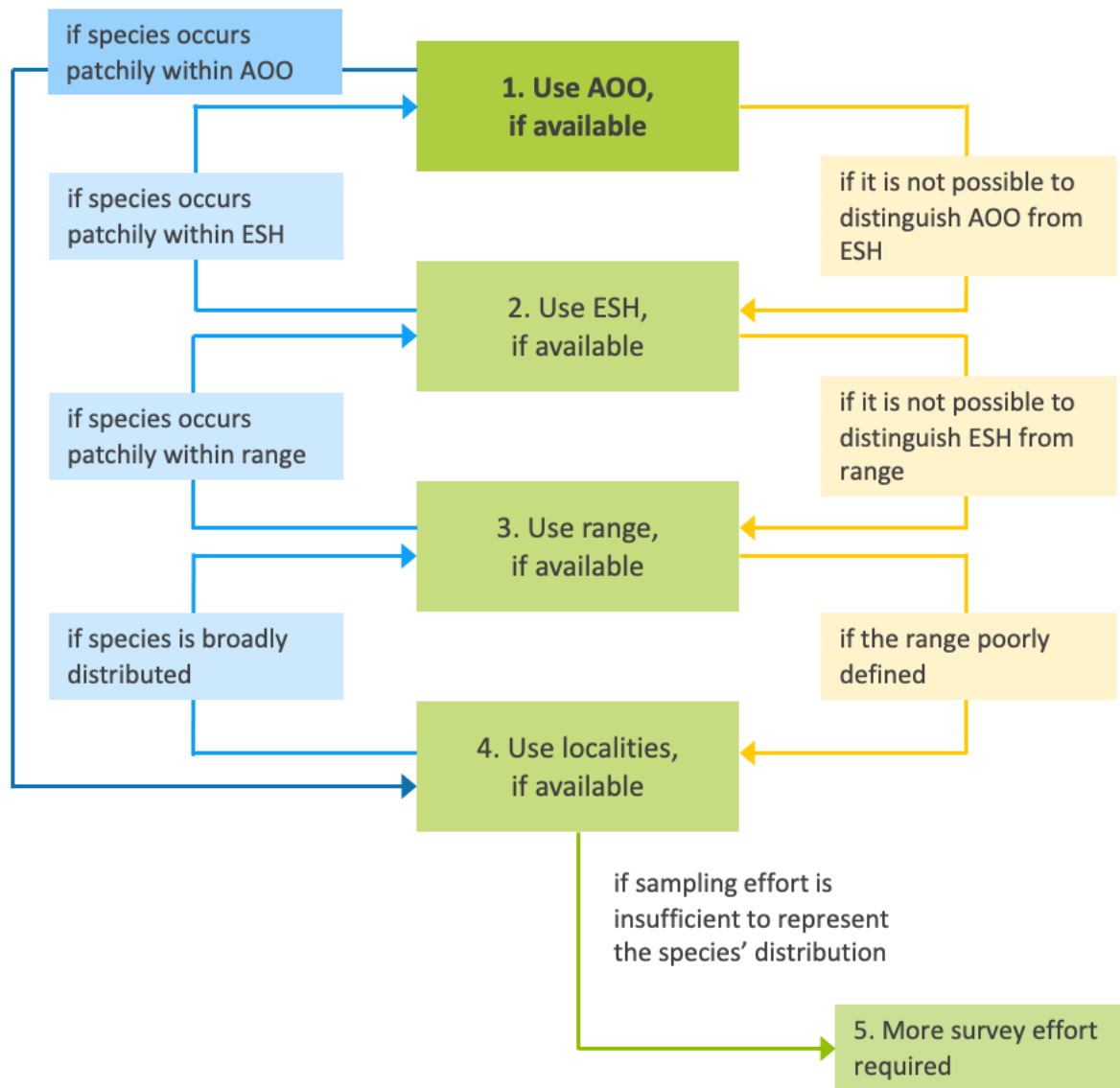


Figure 3.1.2 Selecting among area-based parameters and localities. *Source: Compiled by the KBA SAC.*

For most species, high quality data will only be available for one or two assessment parameters.

For each species, the same assessment parameter must be used at the global and site levels, and estimation methods should be the same, or as consistent as possible, to ensure that population-size estimates at the global and site levels are directly

comparable and enable calculation of the proportion of the **global population size** held at the **site** (see Section 9.3 for further details).

Global estimates of assessment parameters must be based on the entire **range**¹⁰. For example, if estimates of numbers of **mature individuals** are only available for part of the **range**, **KBA Proposers** should consider alternative assessment parameters for estimating the proportion of the **global population size** at a **site**. Using numbers of **mature individuals** from just a subset of known **localities** as a conservative estimate of the **global population size** would be equivalent to reducing the **thresholds** in the **KBA Standard**.

Estimates of abundance and distribution are likely to become less accurate over time. Assessment parameters based on data collected more than 8-12 years before the assessment should be used cautiously and only if available data indicate that there have not been significant changes in **global** or **site-level population size** or distribution patterns (see also Section 9.2.1).

How reliability is judged varies by parameter, but all assessment parameters should be based on an adequate representative sampling strategy; methods for estimating the number of **mature individuals** need to be appropriate for the species; **range** maps should follow the **IUCN Red List Mapping Standards** (see also Appendix III.1); **ESH** and **AOO** should be validated (see Appendix III); and species identification and geographical coordinates need to be accurately recorded for **localities**.

For documentation requirements, please see Section 3.1 for number of **mature individuals** and Sections 3.5-8 for area-based assessment parameters and **localities**.

Selecting the best available assessment parameter will often be a matter of compromise; it is better to use an assessment parameter for which there are recent reliable estimates at both **global** and **site** levels than one for which the **site** estimate is recent and reliable and the **global** estimate is old or unreliable, or *vice versa*.

KBA Proposers are asked to provide a brief explanation for their choice of best assessment parameter for each species from available options when submitting a **KBA** proposal.

¹⁰ Only populations considered “wild” should be included in estimates of assessment parameters (see Section 2.2.4).

What happens if different assessment parameters point to different conclusions?

Where different assessment parameters point to different conclusions, **KBA Proposers** should use the best available data and justify that choice. The better the data available on a population's distribution, the more likely it is that a **site** that actually qualifies as a **KBA** will meet the **thresholds**.

What if assessment parameters derived from the IUCN Red List account need updating?

For species that have been assessed for the **IUCN Red List**, estimates of the **global** number of **mature individuals**, **range** and **AOO** provided in the **IUCN Red List** account will be pre-filled in the **WDKBA** when it is fully functional.

If any estimates of the **global** number of **mature individuals**, **range** or **AOO** provided in a species' **IUCN Red List** account need updating to support **KBA** identification, **KBA Proposers** should consult with their **KBA RFP** who will liaise with the **IUCN SSC Red List Unit**. The **IUCN Red List Unit** will know which **IUCN SSC Red List Authorities** are responsible for overseeing assessments of the species and can determine whether the existing **IUCN Red List** assessment can be corrected or a reassessment is required.

The best solution will be for the **IUCN Red List** account to be updated first, before the **KBA** proposal is submitted. If this is unlikely to happen within the next year, a new estimate of the **global** number of **mature individuals**, **range** or **AOO** may be used, but must be approved by the relevant **IUCN SSC Red List Authorities** before the **KBA** proposal is submitted. Documentation of this approval must be provided with the proposal.

Can the proportion of the global population size at a site be rounded up?

No – estimates of the proportion of the global population size at a site should not be rounded up, as that would have the effect of reducing the threshold. For example, when applying subcriterion A1b, which has a threshold of $\geq 1\%$, if any percentage above 0.5% was rounded up to 1%, this would have the effect of reducing the threshold to $>0.5\%$. The same principle applies to ecosystem extent.

In cases where the proportion of the global population size held at a site falls just short of the threshold based on a relatively coarse assessment parameter such as range, **KBA Proposers** are encouraged to consider using a more refined assessment parameter,

such as ESH, instead, especially if there are areas within the range that clearly do not represent suitable habitat (e.g., a large lake for a terrestrial species).

What if a relevant assessment parameter is not provided in the IUCN Red List account?

KBA Proposers should also consult with their KBA RFP who will liaise with the IUCN Red List Unit before submitting KBA proposals based on new estimates of global population size, range or AOO for species with an IUCN Red List account, even if there is no existing estimate in the account. In a few cases, a new parameter estimate will have implications for the current IUCN Red List status assessment. In such cases, IUCN SSC Red List Authority approval is encouraged but not required.

What if the number of mature individuals (or other assessment parameter) is known to be increasing or decreasing significantly over time at the global or site level?

KBAs should be identified on the basis of the current presence of biodiversity elements, according to the KBA Standard (IUCN, 2016). If the number of mature individuals, range, ESH, AOO or number of localities is known to be increasing or decreasing at significantly different rates at the global or site level, then past data on population size should be projected forward to the current time to estimate the proportion of the global population size currently found at the site. This is especially important if these data were collected more than 8-12 years before the assessment (see Section 9.2.1).

Does the same parameter need to be used for all species at a proposed site?

When determining either the proportion of the global population size at the site, KBA Proposers should use the assessment parameter that provides the best available data for each individual species. In the case of multi-species criteria (i.e. B2, B3), it is not necessary to use the same assessment parameter for all species in an assemblage.

3.2 Number of mature individuals (Criteria A1, B1-3, D1-3, E)

For Criteria A1, B1-3 and D1-3 the proportion of the global population size can be observed or inferred through any of the following:

- (i) number of mature individuals.

For Criterion E, targets may be set in terms of numbers of mature individuals.

Why focus on mature individuals?

The **global population size** and **population size** at a **site** are both measured in terms of **mature individuals** because this can be measured more consistently across species than the total number of individuals, given the wide variation in life history strategies and life forms.

Whenever number of **mature individuals** is used as the assessment parameter, the **global** and **site-level population-size** estimates submitted to the **WDKBA** must be provided in terms of **mature individuals**, even if the data used to construct these estimates were derived from a subset of **mature individuals** or some other index. This is the best way to ensure that **population-size** estimates for each species are consistent across the **WDKBA** and with the **IUCN Red List**. It also facilitates the review and confirmation process.

How are mature individuals defined?

The definition of **mature individuals** in the **KBA Standard** (IUCN, 2016) is the same as the definition used by the **IUCN Red List**: “The number of individuals known, estimated or inferred to be capable of reproduction as defined in IUCN (2012a).”

For species that have been assessed for the **IUCN Red List**, **KBA Proposers** should use the definition of **mature individuals** in the **IUCN Red List** assessment. For species from **taxonomic groups** that have not yet been assessed for the **IUCN Red List** (or for which the above information is unavailable), **KBA Proposers** should follow the detailed guidance on defining **mature individuals** in the **IUCN Red List Guidelines** (IUCN SPC, 2022). The guidance below is derived from the **IUCN Red List Guidelines** (IUCN SPC, 2022, Section 4.3).

When determining the number of **mature individuals**, the following points should be borne in mind:

- "Reproduction" means production of offspring (not just mating or displaying other reproductive behaviour).
- **Mature individuals** that will never produce new recruits should not be counted (e.g., densities are too low for fertilisation).
- In the case of populations with biased adult or breeding sex ratios, it is appropriate to use lower estimates for the number of **mature individuals**, which take this into account.
- Reproducing units within a clone should be counted as individuals, except where such units are unable to survive alone (e.g., corals).

- In the case of taxa that naturally lose all or a subset of mature breeding individuals at some point in their life cycle, the estimate should be made at the appropriate time, when **mature individuals** are available for breeding.
- Reintroduced individuals must have produced viable offspring before they are included in counts of **mature individuals** (IUCN, 2012a).

What if the ratio of mature individuals to population counts varies spatially?

For some species, the number of **mature individuals** may be estimated based on population counts or some other index that is easier to count reliably than **mature individuals**.

The proportion of all individuals at a **site** should provide a reasonable approximation of the proportion of **mature individuals** at a **site** if the mature/immature ratio is similar at **global** and **site** levels. For example, if the mature/immature ratio is 50/50 at both **global** and **site** levels, a **site** that holds 10% of **global population size** of all individuals would be expected to hold 10% of the **global population size** of **mature individuals**. In contrast, if the species distribution is characterised by spatial segregation of life stages (e.g., juveniles vs **mature individuals**) or the mature/immature ratio is known to differ at **global** and **site** levels, then **KBA Proposers** should account for this information.

Likewise, if the ratio of some other population index that is easier to count reliably (e.g., nests, pups, breeding pairs) to **mature individuals** is similar at **global** and **site** levels, then the relative value of the index at **global** and **site** levels should provide a reasonable approximation of the proportion of **mature individuals** at a **site**. For example, if the estimated **global population size** is 10,000 **mature individuals**, but approximately 25% of **mature individuals** skip breeding each year throughout the **range** (i.e. the annual breeding **population size** is 7,500 **mature individuals** or 3,750 breeding pairs), then a colony with more than 375 breeding pairs would meet the 10% **threshold** under Criterion B1.

What if the sex ratio is imbalanced?

If the sex ratio is imbalanced but similar at **global** and **site** levels, then **KBA Proposers** may use **mature individuals** of either or both sexes as the basis for estimating the proportion of the **global population size** at a **site**.

However, if the sex ratio is imbalanced and known to differ at **global** and **site** levels, then **KBA Proposers** should focus on the limiting sex and use a ratio-based approach when estimating **population size** at both **global** and **site** levels. For species in which females bear and raise young, the limiting sex will generally be females, unless males

are severely under-represented. For example, if females are the limiting sex for a species, breeding sites that regularly hold >10% of the global population size of mature females would qualify under Criterion B1, even if few mature males are present. (Marine turtles provide a relevant example here.)

Where can KBA Proposers find global population-size estimates for species that have been assessed for the IUCN Red List?

For species that have been assessed on the IUCN Red List, KBA Proposers seeking to use mature individuals as an assessment parameter must use the global number of mature individuals in the IUCN Red List account, if provided, unless there are clear and compelling reasons for using a different estimate (see below). This estimate will be pre-filled in the WDKBA when it is fully functional. If no global estimate is pre-filled in the WDKBA, KBA Proposers should check the Justification and Population sections of the IUCN Red List account, as information may be provided there.

For some species, the IUCN Red List account only provides a rough estimate of population size. In such cases, KBA Proposers may use a more precise population-size estimate, with supporting data, as long as that estimate is consistent with the IUCN Red List account and does not point to a change to the species' IUCN Red List category. (For example, if the IUCN Red List account provides an estimate of greater than 2,500 mature individuals, a KBA proposal based on a global population-size estimate of 3,000 mature individuals would be consistent with this, but not one based on 2,000 mature individuals.) Information on global population size is not available for all species assessed for the IUCN Red List.

The following reasons for using a different estimate of global population size may be considered clear and compelling:

- i. The IUCN Red List account is flagged as “needs updating”;
- ii. New data are available showing that the global population-size estimate has changed significantly since the most recent IUCN Red List assessment;
- iii. The IUCN Red List account gives an estimate that it acknowledges is not the estimate of the total global population size but only partial and data now exist to estimate the global population size.

The best solution in each case is for the IUCN Red List account to be updated first, before the KBA proposal is submitted. If this is unlikely to happen within the next year, a new global population-size estimate may be used, but must be approved by the relevant IUCN SSC Red List Authority before the KBA proposal is submitted (see Section 3.1). Documentation of this approval must be provided with the proposal.

Ideally, the new [global population-size](#) estimate will be published in a peer-reviewed journal article or report that can be cited. If not, the details of how the [global population-size](#) estimate was derived must be described in documentation submitted to the [IUCN SSC Red List Authority](#).

Where can KBA Proposers find existing global population-size estimates for species that have not been assessed for the IUCN Red List?

If an estimate of the [global](#) number of [mature individuals](#) has previously been confirmed for the species, this estimate will be pre-filled in the [WDKBA](#) when it is fully functional. In the meantime, [KBA Proposers](#) seeking to use [mature individuals](#) as an assessment parameter should check whether the species has already been confirmed as a [trigger](#) species in the [WDKBA](#) and use the same [global](#) estimate unless new data are available showing that this has changed significantly.

If a [global](#) estimate of the number of [mature individuals](#) has not previously been confirmed for the species, possible sources of information on the [global](#) number of [mature individuals](#) include [IUCN Red List Authorities](#), [NatureServe Explorer](#), national authorities, and the scientific literature.

How can KBA Proposers estimate the number of mature individuals at the global or site level?

A complete count of all [mature individuals](#) in the [global population](#) is only possible for very few species. A wide range of valid methods for estimating [population size](#) is available for other species. A population index is also acceptable (e.g., number of breeding pairs), as long as the relationship between the index and the actual number of [mature individuals](#) is expected to be similar at [global](#) and [site](#) scales. It is beyond the scope of the [KBA Guidelines](#) to provide detailed guidance on how to estimate the number of [mature individuals](#) at the [global](#) or [site](#) level, given the wide range of valid methods available. However, the following principles apply:

- i. For each species, the method used to determine the number of [mature individuals](#) should be scientifically valid and appropriate for the species (i.e. should be acceptable for publication in the peer-reviewed literature).
- ii. For some species, the number of [mature individuals](#) may be estimated based on some proxy that is easier to count reliably (e.g., nests or chicks for some birds; pups for some seals).
- iii. In many cases, estimates of [population size](#) will be based on sampling, such as counts of the number of individuals in representative samples of the habitat (e.g., point counts, transects quadrats); estimates of the number of individuals in

representative samples of the habitat using distance sampling (Buckland et al. 2001), individual mark-recapture (Amstrup et al., 2010), or other methods that account for imperfect detection; or methods based on indirect indicators of abundance, such as scat or footprint surveys (e.g., Jachmann, 2012).

- iv. Methods that do not involve a count of the entire **population size** (at the **global** or **site** level) should take account of habitat suitability, where possible, rather than assume that densities are uniform across the **site** or **AOO**, **ESH**, or **range**.
- v. For each species, the method used to determine the number of **mature individuals** should be the same, or as consistent as possible, between the **global** and **site** levels (i.e. methods should not be expected to produce significantly different estimates for the same population (e.g., because one method accounts for imperfect detection and another does not)).

For each species that has not been assessed for the **IUCN Red List** or for which the **IUCN Red List** account does not quantify **mature individuals**, information on how the **global** number of **mature individuals** was estimated should be documented in the **KBA** proposal.

Should KBA Proposers use the lowest plausible estimate of the global population size as a precautionary approach?

No. A precautionary approach is built into the **thresholds** provided in the **KBA Standard**. Using the lowest plausible estimate rather than the best estimate of the **global population size** would be equivalent to reducing the **thresholds** in the **KBA Standard**. (See also Section 9.3 on **uncertainty**.)

What if the number of mature individuals at the global or site level is characterised by significant fluctuations or uncertainty?

See Section 3.1 on selecting assessment parameters and Section 9.3 on **uncertainty** (including ecological variation). Note that the recommendation in the **IUCN Red List Categories and Criteria** (IUCN, 2012a) to use a lower **population size** estimate (often much less than the mean) for species with fluctuating **population size**, is not appropriate in the context of **KBA** assessment.

Should number of mature individuals be used as the assessment parameter for species listed as CR (PE) or CR (PEW)?

For some species listed as , the IUCN Red List account gives the global number of mature individuals as 0-49 (e.g., Bob's Robber Frog, *Craugastor punctariolus*, CR (PE)). Number of **mature individuals** should not be used as the assessment parameter in this

situation, as it will not be possible to provide a reliable estimate of the number of **mature individuals** at the **site** level. Area-based assessment parameters or number of **localities** should be used instead.

3.3 Reproductive units (Criteria A1, B1, B3, E)

Why are reproductive units included in the thresholds for some species-based criteria?

Reproductive units are included in the **thresholds** for some species-based criteria because the intent of the **KBA Standard** is to identify **sites** that **contribute significantly** to the **global persistence** of **biodiversity**. The **reproductive-units thresholds** are intended to prevent identification of **KBAs** where the species occurs in very low numbers and the population is unlikely to maintain itself beyond the current generation. (Note that this is not the same as having a minimum viable population.) The **reproductive-units threshold** is especially important where **population size** is inferred through area-based assessment parameters because it provides confirmation of the species' presence at the **site** and reduces the risk of including **vagrant** records.

How are reproductive units defined?

The **KBA Standard** defines **reproductive units** as: "The minimum number and combination of **mature individuals** necessary to trigger a successful reproductive event at a **site** (Eisenberg, 1977). Examples of five **reproductive units** include five pairs, five reproducing females in one harem, and five reproductive individuals of a [monoecious] plant species."

KBA Proposers are asked to provide a brief description of how a **reproductive unit** is defined for each **trigger** species proposed under Criterion A1, B1, B3, or E. For each species, the definition of **reproductive units** should be derived from the definition of **mature individuals**. **Reproductive units** may be based on the limiting sex where relevant. See **IUCN Red List Guidelines** (IUCN SPC, 2022, Section 4.3.1) for detailed discussion of several special cases including clonal colonial organisms and sex-changing organisms. Additional examples of 5 **reproductive units** include:

- birds: 5 active nests; 5 pairs; or 5 mature females and at least 1 mature male in lekking species;
- amphibians: 5 mature females and at least 1 mature male for most species; 5 pairs for species that provide biparental care;
- turtles: 5 mature females for marine turtles on nesting beaches;

- fish: 5 mature females and at least 1 mature male for most species; 5 pairs for species that form bonded pairs (e.g., some seahorse species);
- insects: 5 females and at least 1 male for non-social insects; 5 colonies with a single reproducing queen each for social insects; 5 reproductive females for parthenogenetic insects;
- cooperative breeders: 5 cooperative units (e.g., 5 packs of African Wild Dog, *Lycaon pictus*);
- fungi: 5 **mature individuals**;
- plants: 5 **mature individuals** for self-fertilising monoecious or hermaphroditic species;
- clonal species: generally 5 distinct clones¹¹.

As with **mature individuals**, **reproductive units** should be capable of reproduction. Individuals that will never produce new recruits (for example, individuals of a species that is sedentary when mature (e.g., abalone species) where densities are too low for fertilisation) should not be counted. However, evidence of successful reproduction is not generally required.

Are counts of reproductive units required?

No. **KBA Proposers** are required to confirm that the relevant **reproductive-units threshold** is met (e.g., the number of **reproductive units** is at least 5 or at least 10 depending on the subcriterion), but are not required to provide counts of **reproductive units** beyond that. If actual counts are readily available, **KBA Proposers** can choose to provide this information as it may be useful for **KBA** monitoring.

What if males and females cannot be readily distinguished?

For species in which males and females cannot be readily distinguished, the **reproductive-units threshold** should be translated into the equivalent number of **mature individuals** (e.g., if 10 **reproductive units** = 10 pairs, this is equivalent to 20 **mature individuals**). However, if there is evidence of a severely imbalanced sex ratio, **KBA Proposers** should increase efforts to assess whether the minimum number of **reproductive units** does indeed occur at the **site**.

¹¹ Exceptions may be made for extensive clonal colonies with a high probability of individual persistence (e.g., a clonal colony of Quaking Aspen (*Populus tremuloides*) in Fishlake National Forest (Utah, USA) occupies nearly 50 hectares and is estimated to be several thousand years old).

What about sites outside the breeding range?

“Breeding” here refers to mating and other processes that require **reproductive units**, such as incubation and chick-rearing in many bird species. For **sites** where breeding does not occur (e.g., **sites** outside the breeding range), the **reproductive-units threshold** should be translated into the equivalent number of **mature individuals** (e.g., if 10 **reproductive units** = 10 pairs, this is equivalent to 20 **mature individuals**; for sexually segregated species, this may be 20 mature females or 20 mature males). Densities do not need to be sufficient to enable reproduction at **sites** where breeding does not occur.

How is the reproductive-units threshold applied to species listed as Critically Endangered (Possibly Extinct) or Critically Endangered (Possibly Extinct in the Wild)?

See Section 2.4.1.

What about species-based criteria that do not have reproductive units included in the threshold?

Some species-based criteria (i.e. A1e, B2, B3a, B3c, D1-D3) do not include a **reproductive-units threshold**. For non-threatened species, it is very likely that a **site** that meets the **population-size threshold** would hold at least 10 **reproductive units**. Nevertheless, **KBA Proposers** must still confirm the **regular** or **predictable** presence of each **trigger** species at **sites** proposed under these criteria (see Section 9.2.3), except for species listed as CR (PE) or CR (PEW) on the **IUCN Red List**.

In **sites** where breeding occurs, numbers and densities should be sufficient to support successful reproduction and **KBA Proposers** are encouraged to confirm presence in terms of **reproductive units** if possible (e.g., at least 10 **reproductive units**). This information may prove useful if additional criteria are considered in the future. It was not the intent of the **KBA Standard** that these criteria provide an easier alternative to Criteria A1 and B1 for safeguarding **globally threatened** or individual **geographically restricted** species.

What types of evidence can be used to assess whether the reproductive units threshold is met?

See Section 9.2.3.

3.4 Overview of area-based assessment parameters and localities (A1, B1-3, E)

Figure 3.4 provides a schematic demonstrating the **range**, **ESH**, **AOO**, and **localities** or occurrences. (See Appendix I for complete definitions.)

Range encompasses the current known limits of distribution of a species within the major system(s) in which a species occurs, accounting for all known, inferred or projected sites of occurrence, including conservation translocations outside native habitat but excluding vagrancies. Large areas of absence resulting from unsuitable physical geography, climate or habitat may also be excluded.

ESH refers to the area of habitat available to a species within its **range**, and thus is a refinement of **range** that may take additional environmental conditions and habitat information into account to exclude unsuitable areas. For some species, **range** may approximate **ESH**.

AOO is the area of habitat that is actually occupied by the species, based on known, inferred and projected occurrences.

Known **localities** are the specific points, defined by latitude and longitude, where a species is known to occur. Inferred/projected occurrences are points where the species is inferred/projected to occur.

For example, a freshwater invertebrate occurs in shallow sandy habitat in freshwater lakes (Fig. 3.4). A single **locality**, in a distant lake with no similar habitat, is assumed to be a **vagrant** occurrence (perhaps dropped by a bird). All other known **localities** occur within a single large lake. Additional occurrences are inferred for shallow sandy habitat that has not been surveyed in the same lake as known **localities**, and projected for similar habitats in a neighbouring lake connected by a river. This lake has never been surveyed and so has no known **localities**. The **range** comprises all freshwater lakes with known, inferred, or projected occurrences, and excludes terrestrial areas. The **ESH** comprises all shallow sandy habitats within the **range**. The **AOO** comprises 2 x 2 km grid cells with known, inferred, or projected occurrences. A few areas of shallow sandy habitat within the **range** are currently occupied by an invasive predatory fish — the freshwater invertebrate does not currently occur in these areas, so they are included in **ESH** but not in **AOO**.

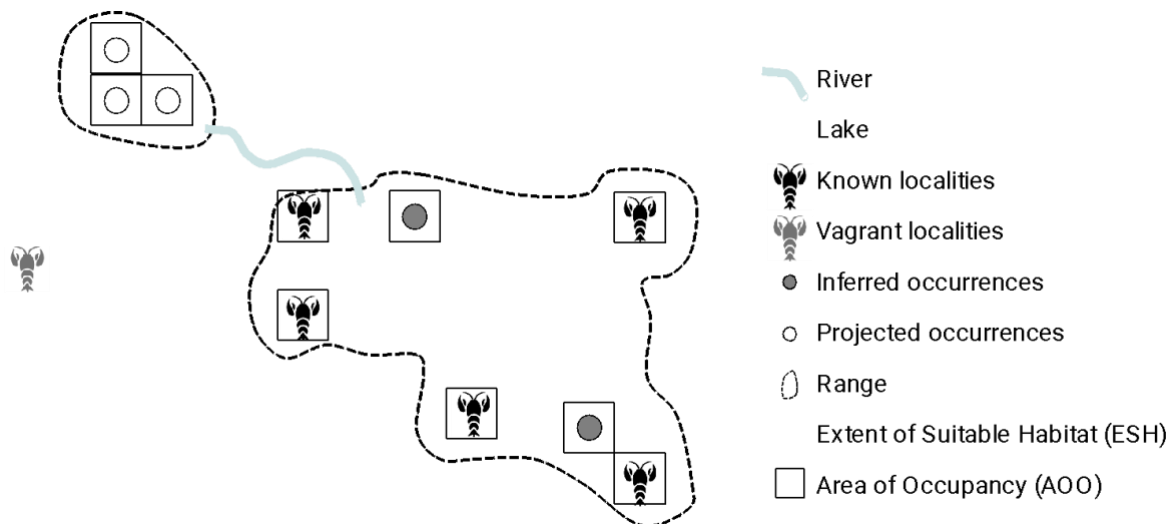


Figure 3.4 Schematic demonstrating localities, range, ESH and AOO for a hypothetical species. *Source: Compiled by the KBA SAC.*

Can area-based assessment parameters be applied to species with spatially dynamic habitats?

For species with spatially dynamic habitats, including many pelagic marine species, **AOO** and **ESH** are seasonally and interannually variable at both **global** and **site** levels. **AOO** and **ESH** will not generally provide a stable and reliable basis for inference about the proportion of the **global population size** at a **site** in this context, and should not be used.

How can area-based assessment parameters be applied to migratory species?

For migratory species, estimates of known **localities**, **AOO**, **ESH**, or **range** at the **global** and **site** levels must be calculated separately for each season, such that percentages of the **global population size** in the **site** can be inferred for the relevant season. For example, a species will trigger a **KBA** if the **ESH** in its breeding **range** at the **site** exceeds the **threshold** percentage of the **global ESH** in its breeding **range**.

Area-based parameters (i.e. **range**, **ESH**, **AOO**) and **localities** do not provide a good proxy for the population distribution of species when on migration (e.g., at bottleneck and stop-over **sites**), so should not be used as the basis for identifying **KBAs** during this **life-cycle process**. The proportion of the **global population size** held at a **site** cannot be inferred using area-based parameters or **localities** under Criterion D1.

How is the proportion of the global population size at a site estimated using area-based assessment parameters?

When calculating area at the **global** or **site** scale, **range**, **ESH** or **AOO** maps should be projected into the World Cylindrical Equal Area projection (specifically “+proj=cea +lat_ts=0 +lon_0=0 +x_0=0 +y_0=0 +datum=WGS84 +units=m +no_defs”) in a GIS package. This projected coordinate reference system can be referenced by the code “ESRI: 54034” in QGIS and “World_Cylindrical_Equal_Area” in ArcGIS. Area should be reported in km². (Note that the **IUCN Red List range** polygons come with an area calculation but KBA Proposers should recalculate area using the standard projection and km².)

3.5 Range (Criteria A1, B1-3, E)

How is range defined?

The **KBA Standard** (IUCN, 2016) defines **range** as: “The current known limits of distribution of a species, accounting for all known, inferred or projected sites of occurrence (IUCN, 2012a), including conservation translocations outside native habitat (IUCN SPSC, 2014)¹² but not including vagrancies (species recorded once or sporadically but known not to be native to the area)” (Fig. 3.5). (See Section 9.2.2 for definitions of known, inferred and projected occurrences.) For the purposes of **KBA** identification, **range** should not include areas where the species no longer exists (i.e. **range** refers to the current distribution, rather than the historic distribution; IUCN, 2016), or where the species has been introduced (except for conservation translocations). This definition is consistent with the use of “**range**” in **IUCN Red List** assessments, and is represented by **IUCN Red List range** map polygons coded as extant and native/reintroduced/assisted colonisation.

¹² Note that IUCN SPSC (2014) has been updated to IUCN SPS (2019).

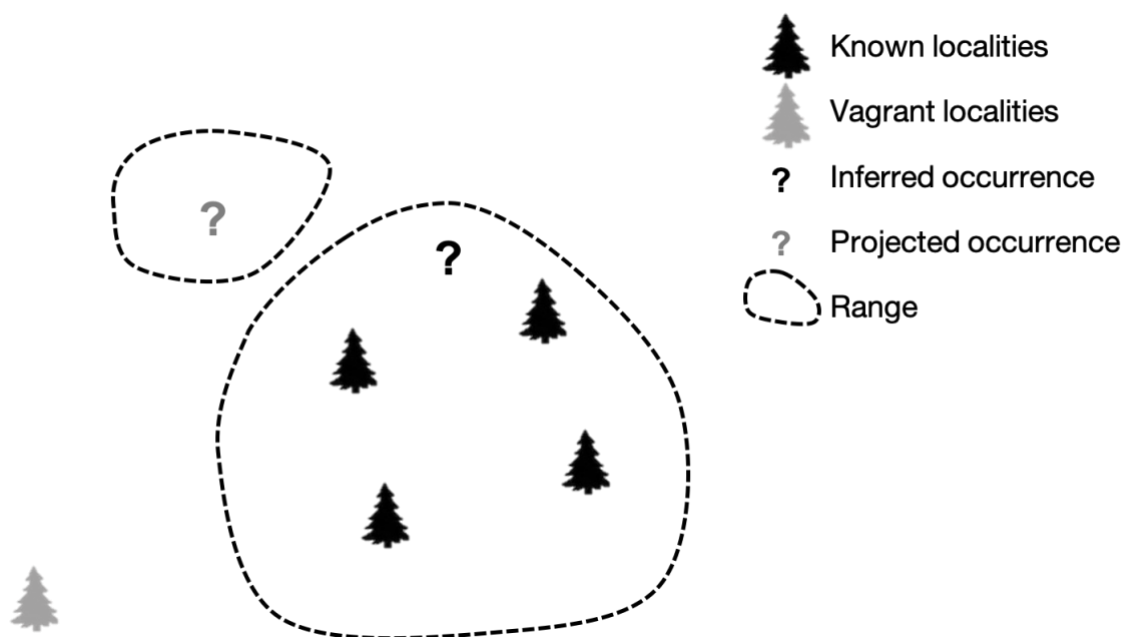


Figure 3.5 Schematic demonstrating range for a hypothetical species. *Source: Compiled by the KBA SAC.*

Range typically excludes large areas of absence resulting from unsuitable physical geography (e.g., altitude, bathymetry, hydrology), climate or habitat. **Range** may be represented by a set of polygons rather than a single polygon.¹³

Where can KBA Proposers find data on range for species that have been assessed for the IUCN Red List?

For species that have been assessed for the **IUCN Red List**, **KBA Proposers** should use the **range** map in the **IUCN Red List** account (see Appendix III for details).

For all species with **range** maps on the **IUCN Red List**, total **range** area (for resident species) and breeding and non-breeding **ranges** (for migratory species with distinct breeding and non-breeding **ranges**) will be calculated by the **KBA Secretariat**. This information will be used to pre-fill **global range** areas in the **WDKBA** when it is fully functional. In the meantime, **KBA Proposers** should download range polygons from the **IUCN Red List** account and follow the guidelines in Appendix III to estimate the **range** area at **global** and **site** levels.

¹³ Note that “range” differs from EOO, which is calculated as the minimum convex polygon around all known, inferred or projected sites of occurrence. EOO is used in IUCN Red List assessments as a measure of the spatial spread of risk. It may include large areas that are unsuitable (including marine areas in the case of terrestrial species and vice versa), and is not used in KBA identification.

If there is no **range** map or the **range** map in the **IUCN Red List** account needs updating, **KBA Proposers** should follow the **IUCN Red List Mapping Standards** to develop a new distribution map for estimating **range** (see also Appendix III). The resulting **range** map should be submitted to the relevant **IUCN SSC Red List Authority**.

If there is an existing **range** map in the **IUCN Red List** account, the relevant **IUCN SSC Red List Authority** must approve any updates before a **KBA** can be proposed that is inconsistent with the existing **range** map for the proposed **trigger** species and before **range** can be used as the assessment parameter. Documentation of this approval should be provided with the **KBA** proposal. If there is no existing **range** map, prior approval by the **IUCN SSC Red List Authority** is encouraged but not required.

For taxonomic groups with no **IUCN SSC Red List Authority** or if the relevant **IUCN SSC Red List Authority** is unable to review the new **range** map in a reasonable timeframe, the **KBA Proposer** should submit the new **range** map to their **KBA RFP** for expert review and approval.

Following review and approval, the **range** map will be available for use in future **KBA** proposals.

Where can KBA Proposers find data on range for species without an IUCN Red List account?

If the **range** has previously been confirmed for the species, the global **range** estimate will be pre-filled in the **WDKBA** when it is fully functional. In the meantime, **KBA Proposers** seeking to use **range** as an assessment parameter should check whether the species has already been confirmed as a **trigger** species in the **WDKBA** and use the same **global** estimate and **range** map unless new data are available showing that these have changed significantly. For species without an **IUCN Red List** account, confirmed **range** maps can be obtained from the **KBA Secretariat**.

If the **range** has not previously been confirmed for the species or the **range** map needs updating, **KBA Proposers** seeking to use **range** as an assessment parameter should follow the **IUCN Red List Mapping Standards** to develop a new distribution map for estimating **range** (see also Appendix III). The resulting **range** map should be flagged for expert review when the **KBA** proposal is submitted to the **WDKBA**. Following review, the **range** map will be available for use in future **KBA** proposals.

When is it important to use consistent range maps for entire taxonomic groups?

Consistent **range** maps are important for identifying **restricted-range** species within a **taxonomic group** for Criterion B2.

Consistent **range** maps are also important as a basis for estimating the median **range** size for a **taxonomic group** for Criterion B3 (see Section 2.7.1). However, the median **range** size can be estimated from a representative sample of species, so data on **range** are not required for the entire **taxonomic group**.

When determining either the proportion of the **global population size** at the **site**, or whether a species is restricted to an **ecoregion** or **bioregion**, **KBA Proposers** should use the best available data for each individual species (see Section 3.1 on selecting assessment parameters). This may be **ESH** rather than **range**, if **ESH** is available and provides better information on an individual species' distribution.

What about migratory species?

For migratory species with well-defined spatially segregated **life-cycle processes**, such as breeding, feeding and migration, Criteria A1, B1-3 can be triggered separately by populations in each spatially segregated life function. For species that have distinct breeding and non-breeding **ranges** identified in **IUCN Red List** assessment maps, breeding and non-breeding **ranges** will typically be assessed separately. (Please see Appendix III for details.)

What if the range map is a standardised buffer

In general, if the **IUCN Red List range** map is a standardised buffer around a single known **locality**, it makes sense to delineate a more realistic **KBA** boundary. If new information on the species' distribution is uncovered during this process, that information should be fed back to the **IUCN Red List** assessors so that the **range** map can be updated. In the meantime, number of **localities** can be used as the assessment parameter.

When is it inappropriate to use range?

If a species' **range** is poorly defined, **localities** may provide better information on the distribution of the **global population size**, especially if the species distribution is highly localised.

For species whose **range** is well defined but that occur patchily within their **range**, **ESH** or **AOO** may provide better information on the distribution of the **global population size**.

3.6 Extent of suitable habitat (ESH, Criteria A1, B1-3)

How is ESH defined?

The **KBA Standard** (IUCN 2016) defines **ESH** as: “The area of potentially suitable ecological conditions, such as vegetation or substrate types within the altitudinal or depth, and temperature and moisture preferences, for a given species (Beresford et al., 2011)” (Fig. 3.6).

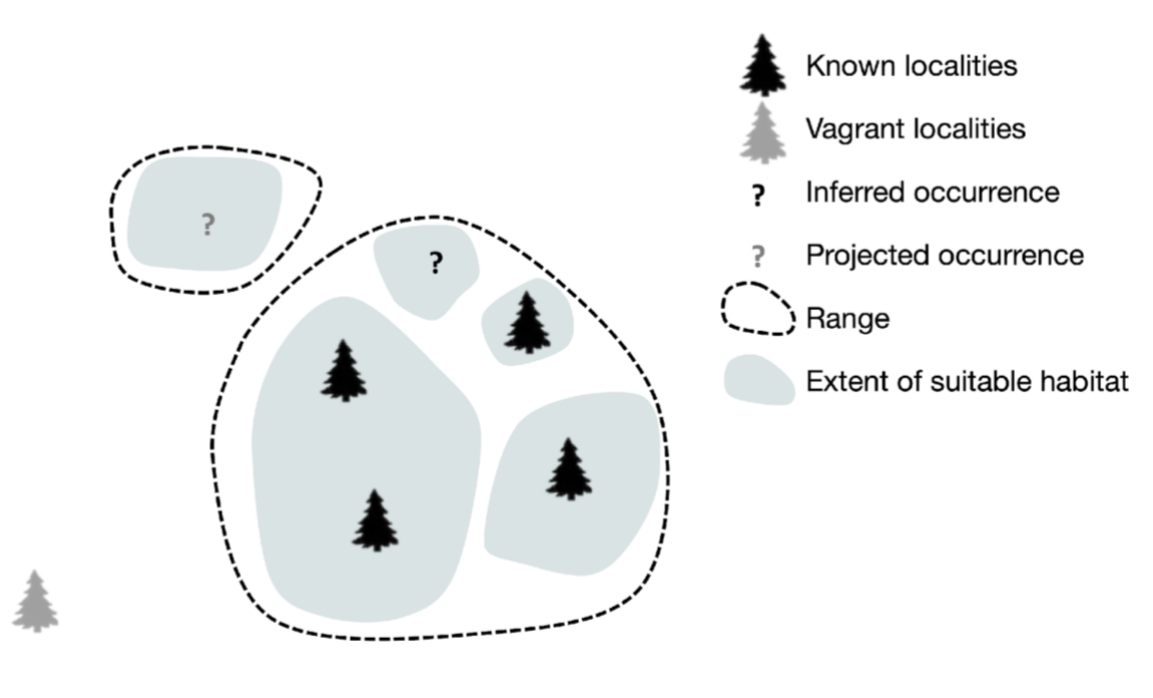


Figure 3.6 Schematic demonstrating extent of suitable habitat (ESH) for a hypothetical species. *Source: Compiled by the KBA SAC.*

ESH refers to the extent of habitat available to a species within its **range** and cannot extend beyond the **range** (Fig. 3.6). **ESH** is a refinement of **range** — for example, a **range** polygon may be clipped to exclude areas that do not contain habitat, or the **range** may be converted into grid cells and cells that do not contain habitat may be removed. For some species, **range** and **ESH** may be similar. **ESH** may encompass a much larger area than **AOO** as **ESH** may include unoccupied habitat within the species' **range**.

ESH is broadly defined to include habitat maps based primarily on expert knowledge (deductive models) or statistical analysis (inductive models). ESH thus includes both the concept of “area of habitat” (AOH), which focuses on deductive models (Brooks et al., 2019), and output from statistical habitat models (see Appendix III.2 for further discussion).

Where can KBA Proposers find data on ESH?

Validated ESH maps are available for mammals and birds and will be provided through the IUCN Red List (spatial downloads page). Validated ESH maps for other taxonomic groups will also be provided when available.

If a validated ESH map exists for the species, the global ESH estimate will be pre-filled in the WDKBA when it is fully functional. In the meantime, KBA Proposers seeking to use ESH as an assessment parameter should check whether the species has already been confirmed as a trigger species in the WDKBA and use the same global estimate and ESH map unless new data are available showing that these have changed significantly.

If there is no validated ESH map or there is scope for improving the existing ESH map, KBA Proposers seeking to use ESH as an assessment parameter should follow the guidance in Appendix III.2 to develop an ESH map. ESH maps may be based primarily on expert knowledge or statistical habitat models and should be validated using independent occurrence data for the species before they are used in KBA assessment. The resulting ESH map should be flagged for expert review when the KBA proposal is submitted to the WDKBA. Following review, the ESH map will be available for use in future KBA proposals.

When is it inappropriate to use ESH?

If a species’ habitat is poorly defined, range may provide better information on the distribution of the global population size.

For species whose habitat is well defined but that occur patchily within their ESH, AOO may provide better information on the distribution of the global population size.

3.7 Area of occupancy (AOO, Criteria A1, B1-3, E)

How is AOO defined?

The KBA Standard (IUCN, 2016) defines AOO as: “The area within the range of a species that is actually occupied (IUCN, 2012a).” It includes inferred or projected

occurrences, but does not include cases of **vagrancy** (Fig. 3.7; IUCN, 2001). AOO must be assessed based on a grid. The **IUCN Red List Guidelines** (IUCN SPC, 2022) strongly recommend a reference resolution of 2 × 2 km for all species when measuring **AOO**, and this is also recommended for **KBA** assessments.

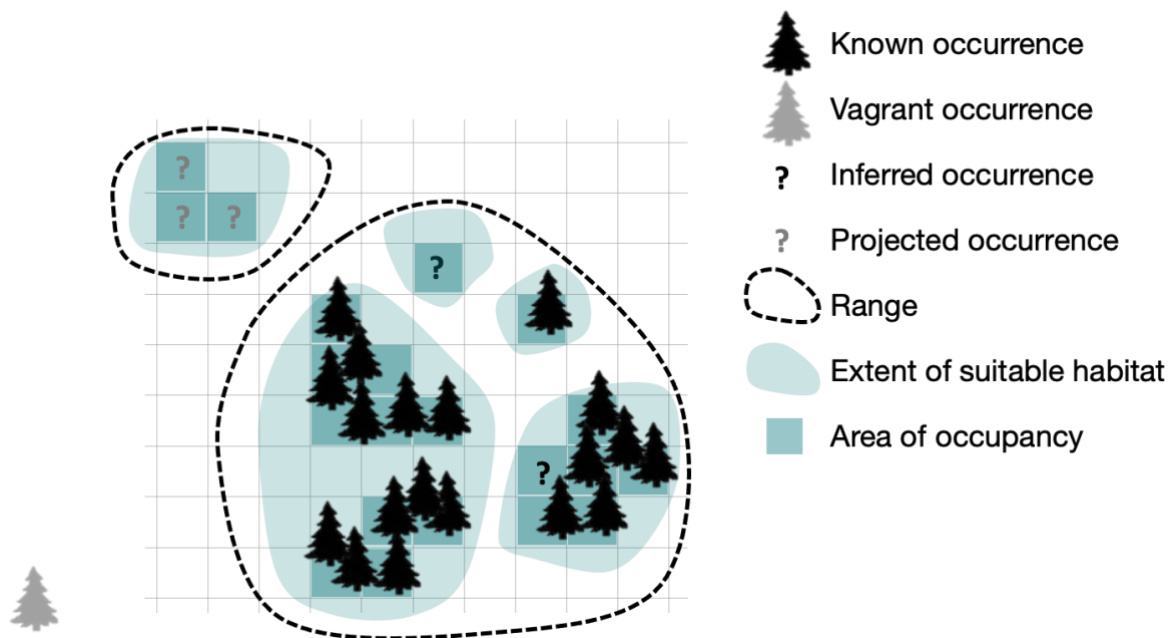


Figure 3.7 Schematic demonstrating area of occupancy (AOO) for a hypothetical species. *Source: Compiled by the KBA SAC.*

For many species, **AOO** may be characterised as a refinement of **range** and **ESH** and range. However, for some species (e.g., some invertebrates), habitat may occur at much finer scales than the standard 2 × 2 km used for **AOO**, and **ESH** may be less than **AOO**.

Where can KBA Proposers find data on AOO?

For species that have been assessed for the **IUCN Red List**, **AOO** may have been defined, and possibly mapped, already. If a validated **AOO** map exists for the species, the global **AOO** estimate will be pre-filled in the **WDKBA** when it is fully functional. In the meantime, **KBA Proposers** seeking to use **AOO** as an assessment parameter should check whether the species has already been confirmed as a **trigger** species in the **WDKBA** and use the same **global** estimate and **AOO** map unless new data are available showing that these have changed significantly. Validated **AOO** maps can be obtained from the **KBA Secretariat**.

AOO must be mapped before it can be used as an assessment parameter. If the IUCN Red List account gives an estimate for AOO, but does not provide an AOO map, KBA Proposers seeking to use AOO as an assessment parameter are encouraged to liaise with the IUCN Red List assessment authors to obtain or develop an AOO map.

If there is no validated AOO map or the AOO map needs updating, KBA Proposers should follow the IUCN Red List Mapping Standards for mapping AOO (see also Appendix III). The resulting AOO map should be flagged for expert review when the KBA proposal is submitted to the WDKBA. Following review, the AOO map will be available for use in future KBA proposals.

When is it inappropriate to use AOO?

KBA Proposers should avoid using AOO when there is insufficient information to distinguish occupied and unoccupied habitat (see Appendix III). In this situation, ESH may provide better information on the distribution of the global population size, even if occupation of habitat is patchy.

KBA Proposers should evaluate carefully whether AOO is the best assessment parameter when species are distributed on very fine scales, such that the standard 2 x 2 km is likely to significantly overestimate the area of occupied habitat. (For example, the patches of stony habitat occupied by the Crau Plain Grasshopper (*Prionotropis rhodanica*, CR) are much smaller than the standard 2 x 2 km grid.) AOO may still be used in this context, if it provides a good representation of the proportion of the global population size at a site. Alternatively, if most habitat is occupied and ESH provides a finer resolution, ESH may be selected over AOO. Number of localities may also be used, as long as each locality represents a discrete population (see Section 3.8).

3.8 Number of localities (Criteria A1, B1-3)

How are localities defined and identified?

The KBA Standard (IUCN, 2016) defines localities as follows: “A sampling locality is a point indicated by specific coordinates of latitude and longitude. Note that the term ‘locality’, as defined here, is fundamentally and conceptually different from the term ‘location’ used in the IUCN Red List (IUCN, 2012a).”

Known localities refer to known points of occurrence, and do not include inferred or projected occurrences. (See Section 9.2.2 for definitions of known, inferred and projected occurrences.) For the purposes of KBA identification, old records from areas where the species no longer occurs and vagrancies (i.e. records from areas where the

species has only been recorded once or sporadically and is known not to be native) are excluded from known [localities](#).

Each [locality](#) should represent a discrete population, to the extent this can be inferred, given the degree of habitat fragmentation and what is known about the dispersal capabilities of the species. Records that clearly represent multiple replicates of the same population should be treated as a single [locality](#).

If the [IUCN Red List](#) account gives the number of subpopulations for a species, each subpopulation should be treated as a single [locality](#).

While the term ‘[locality](#)’ differs from the term ‘location’ used in the [IUCN Red List](#), the number of locations may provide a reasonable proxy for the number of [localities](#) if each location represents a discrete population. The term ‘location’ defines an area in which a single threatening event (e.g., a disease outbreak or hurricane) can rapidly affect all individuals of the species present. The scale of a ‘location’ thus depends on the area covered by the threatening event, which may be smaller than, similar to, or larger than a species’ population (IUCN, 2012a). [KBA Proposers](#) should clarify whether each ‘location’ refers to a discrete population before using number of locations as a proxy for number of [localities](#).

Where can locality data be found?

If a [global](#) estimate of number of [localities](#) has previously been confirmed for the species, it will be pre-filled in the [WDKBA](#) when it is fully functional. In the meantime, [KBA Proposers](#) seeking to use number of [localities](#) as an assessment parameter should check whether the species has already been confirmed as a [trigger](#) species in the [WDKBA](#) and use the same [global](#) estimate unless new data are available showing that this has changed significantly.

If a [global](#) estimate of the number of [localities](#) has not previously been confirmed for the species (or the previous estimate needs updating), [KBA Proposers](#) seeking to use number of [localities](#) as an assessment parameter should check the data sources given below and compile [locality](#) data to estimate the global number of [localities](#). [Locality](#) data should be checked by an appropriate species expert to ensure that the taxonomy is up-to-date and erroneous records are removed.

Sources of [locality](#) data include museums, herbaria, [GBIF](#) and other citizen science platforms, [Global Seabird Tracking Database](#), [Ocean Biogeographic Information System](#) and [NatureServe’s National Species Dataset](#) (for the US and Canada).

How are thresholds applied to locality data?

Where the **threshold** is $\geq 1\%$, a **site** qualifies as a **KBA** if it represents one of 100 or fewer **localities**; where the **threshold** is $\geq 10\%$, a **site** qualifies as a **KBA** if it represents one of 10 or fewer **localities**.

Localities may be weighted by estimated **population size** (e.g., based on the relative size of habitat patches) given that abundance may vary considerably across **localities**.

When is it appropriate to use number of localities?

Locality information is most useful for species that have a highly localised distribution and for which there is insufficient information to define and delineate **range**, **ESH** or **AOO**. Note that number of **localities** is based on known occurrences only, whereas as **AOO** is based on known, inferred and projected occurrences, so more information about factors underpinning distribution patterns is needed to map **AOO**, **ESH** or **range** than for estimating number of **localities**.

When is it inappropriate to use number of localities?

Where there are sufficient occurrences or the factors underpinning the species' distribution are known, **KBA Proposers** are encouraged to use **AOO**, **ESH** or **range** instead. In particular, where a cluster of occurrences that likely represents a single discrete population (i.e. **locality**) falls partly within and partly outside a **site**, **KBA Proposers** should use **AOO** or some other assessment parameter instead.

Number of **localities** should not be used as the basis for **KBA** identification if sampling effort has been opportunistic or insufficient to assume that known **localities** represent the species' distribution (IUCN, 2016). The judgement that sampling effort has been adequate should be justified in the documentation.

If sampling effort has been inadequate, additional survey work may be required before the species can trigger a **KBA**.

3.9 Relative density or abundance of mature individuals (Criterion B3)

Under subcriterion B3c, "most important occupied habitat" can be observed or inferred through the following assessment parameters:

- (i) density of **mature individuals**.
- (ii) relative abundance of **mature individuals**.

When can relative density or abundance be used?

The **KBA Standard** only specifies [relative] density or relative abundance of **mature individuals** as possible assessment parameters for subcriterion B3c.

The relative density or abundance of **mature individuals** can also serve as a proxy for the number of **mature individuals** in cases where it is not possible to detect or count all individuals in a population (see Section 3.2).

How can KBA Proposers estimate relative density or abundance?

Estimates of relative density or abundance may be based on direct sampling or derived from density distribution models. It is beyond the scope of the **KBA Guidelines** to provide detailed guidance on how to estimate the relative density or abundance of **mature individuals** at the **global** or **site** level using SDMs, but general principles are provided in Appendix III.

For subcriterion B3c, methods for estimating relative density or abundance should be applied consistently across all sampling **localities** and possible **sites**.

How are thresholds applied to data on relative density or abundance?

For subcriterion B3c, see Section 2.7.3.

When is it inappropriate to use relative density or abundance?

Subcriterion B3c is only applicable in situations where, for a particular **taxonomic group** in a particular region, it is not possible to apply whichever of B3a or B3b would otherwise have been applicable (see Section 2.7.1).

In addition, sampling data for estimating relative density or abundance of **mature individuals** must be available at a wide range of **localities** encompassing most of the species' known **range**; any unsampled areas must be unlikely to hold relatively high densities.

3.10 Distinct genetic diversity (Criteria A1, B1-2)

The inclusion of **distinct genetic diversity** as a metric under Criteria A1, B1 and B2 is intended to identify **sites** that **contribute significantly** to the **global persistence** of genetic diversity.

How is distinct genetic diversity defined?

The **KBA Standard** defines **distinct genetic diversity** as follows: “The proportion of a species’ genetic diversity that is encompassed by a particular **site**. It can be measured using Analysis of Molecular Variance [AMOVA] or similar technique that simultaneously captures diversity and distinctiveness (frequency of alleles and the genetic distinctiveness of those alleles).”

How is distinct genetic diversity used to identify sites under Criteria A1, B1 and B2?

Distinct genetic diversity differs from the other assessment parameters in that it refers to the proportion and unique nature of a species’ genetic diversity that is encompassed by a particular area. A **site** holding more than the **threshold** proportion of a species’ **global** genetic diversity can qualify as a **KBA**, even if the proportion of the species’ **global population size** at the **site** is insufficient to trigger a **KBA**.

What measures can be used to assess the proportion of a species’ distinct genetic diversity that is encompassed by a particular site?

AMOVA can be used to estimate the proportion of **distinct genetic diversity** at a given **site** compared to a dataset representing a species’ entire **range**. AMOVA allows a percentage of **distinct genetic diversity** to be ascribed to an entire dataset or to some partitioning of that dataset. Provided sufficient sampling has been carried out, a **site’s** **distinct genetic diversity** can be measured with reference to a species’ entire **range** by subtracting a **site** from the dataset and asking what proportion of the **distinct genetic diversity** is lost (e.g., Table 3.10). (Note that the percentage of **distinct genetic diversity** contributed by each of the remaining **sites** may change when one **site** is selected, depending on how each **site** complements the selected **site**.)

Table 3.10. Example of AMOVA-based analysis of distinct genetic diversity used to identify KBAs for a VU species under Criterion A1b (threshold = 1%) and B1 (threshold = 10%)

	Distinct genetic diversity remaining (%)	Difference (%)	Threshold met
Entire range	100	-	
Site 1 removed	87.8	12.2	A1b, B1
Site 2 removed	93.1	6.9	A1b
Site 3 removed	98.8	1.2	A1b
Site 4 removed	99.5	0.5	

Source: Compiled by the KBA SAC.

Analysis of allele or haplotype frequencies alone provides information on the demographic distinctiveness of a population occupying a [site](#). For the purposes of [KBA](#) identification, analysis of genetic markers should be modified to account for the evolutionary distinctiveness of the alleles in the analysis by incorporating a measure of genetic distance in the calculation (e.g., using DNA sequence dissimilarity). Using allele or haplotype frequencies alone, the analysis may simply detect the signature of recent demographic isolation (e.g., attributable to anthropogenic barriers to gene-flow), as opposed to long-term evolutionary distinctiveness (e.g., attributable to natural barriers such as rivers, mountain ranges, etc.), which are better incorporated by accounting for the evolutionary distinctiveness of the sequences studied.

The increasing use of genomics in conservation biology can provide a framework for identifying the relative importance of evolutionary, demographic and local adaptive diversity in species occupying potential [KBAs](#) (see Funk et al., 2012). The analysis shown in Table 3.10 could be applied to genomic datasets with neutral (demographic) and selected (adaptive) markers, analysed both together (to obtain an estimate of genome-wide divergence) and separately (to obtain an estimate of demographic differentiation and signatures of local adaptation). [KBA NCGs](#) or [KBA Proposers](#) may decide to focus [KBA](#) identification based on [distinct genetic diversity](#) that reflects long-term evolutionary processes driven by natural isolation and/or local adaptation rather than recent anthropogenic isolation and genetic drift.

Where can KBA Proposers find data for analysing distinct genetic diversity?

If [distinct genetic diversity](#) has previously been used as an assessment parameter for the species, this will be indicated in the [WDKBA](#) when it is fully functional. In the meantime, [KBA Proposers](#) seeking to use number of [localities](#) as an assessment parameter should check whether the species has already been confirmed as a [trigger](#) species in the [WDKBA](#). Any new analysis should be contextualised in terms of this previous analysis, if new data are used or a different metric applied.

In some cases the data required for analysing [distinct genetic diversity](#) will exist in the literature. This is most likely for species of conservation concern with restricted distribution, species with restricted genetic diversity, and species that are related to high value domesticated species (e.g., crop wild relatives). However, in most cases, new data will need to be collected, based on the sampling, genetic and data analysis requirements summarised above.

Are there any specific requirements for genetic data used to estimate the proportion of distinct genetic diversity at a site?

Genetic datasets should be evaluated for data quality and rigour before being used for **KBA** identification.

Where possible, genetic data should be taken from recent peer-reviewed literature. Data should ideally comprise nuclear DNA (e.g., microsatellite markers, Single Nucleotide Polymorphisms (SNPs), RAD-seq data or whole genome sequencing data) and, if appropriate, organelle DNA data (mitochondrial and chloroplast sequences). Analyses based on organelle DNA alone should be treated with caution as such studies only provide a partial genealogical history of the population(s) concerned.

A robust sampling design is essential. If potentially important populations are not sampled, or sampling is uneven across the **range**, the results could be biased.

Uncertainty can be reduced by increasing the number of independent genetic markers used and by ensuring that sufficient individuals have been sampled within each gene-pool. The balance between number of markers and number of individuals has long been debated (e.g., Beaumont & Nichols, 1996), but the general consensus is that, provided enough genomic data are sampled, no more than 15 unrelated individuals need be sampled within each gene-pool or potential **KBA** to capture most of the genealogical variance present.

This has led to vigorous debate about how many genomic markers are needed. Traditional AMOVA has used mitochondrial DNA sequences, often alone. This is risky because mitochondrial DNA represents a single maternally inherited haplotype and hence variation within this sequence is inherently non-independent. For traditional genetic markers (e.g., microsatellites), reputable journals have long applied a minimum number of markers required for publication¹⁴. Nuclear DNA studies sampling very few genomic markers (e.g., <8 for microsatellites; <100 for SNPs) should also be treated with caution.

This debate has been largely rendered moot by the arrival of genomic and reduced representation genomic tools such as Genotype By Sequencing, RAD-seq and whole genome resequencing, which yield thousands to millions of such markers. Thus,

¹⁴ This used to be eight markers for wild animal species, and 20 for domestic animal species. These thresholds were not applied to plants because of the difficulty in obtaining markers, or to certain recalcitrant animal groups (e.g., gastropods).

genealogical sampling considerations are now simply a matter of acquiring a sufficient number of unrelated individuals per [site](#).

However, concerns about the number of genetic markers remain relevant when legacy datasets are being used, and the best approach will generally be to combine data from past and current studies. This can prove problematic if the sample sets are mutually exclusive, but triangulation methods can be used, even if just a few common samples are available (e.g., Carroll et al., 2018).

In case of doubt, [KBA Proposers](#) are advised to consult with conservation genetics specialists (e.g., the [IUCN SSC Conservation Genetics Specialist Group](#)).

Are there any specific requirements for documenting the proportion of distinct genetic diversity at a site?

Aside from the above sampling requirements, the main requirement is that data should be reliable, preferably published in the peer-reviewed literature. This includes the raw allele frequencies and their sequences, where appropriate. Such data are usually deposited in databases such as the [Dryad Digital Repository](#), [GenBank](#), the [Sequence Read Archive](#), or in the supplementary materials of the paper itself.

When is it inappropriate to use distinct genetic diversity?

Generally, [distinct genetic diversity](#) should only be used for species whose genetic diversity has been well sampled throughout the [range](#). [Distinct genetic diversity](#) is typically most useful as an assessment parameter for species that have one or more populations that have been genetically isolated over evolutionary time-scales. Such populations often comprise distinct described subspecies or races, but may also be signalled by genetic data indicating genetic isolation over thousands of years or generations. Populations where land-use change or anthropogenic barriers have led to recent subdivision are less likely to harbour [distinct genetic diversity](#).

4. Identifying Key Biodiversity Areas using ecosystem-based criteria (A2, B4)

This chapter provides detailed guidelines on applying the ecosystem-based criteria, A2 and B4. Criterion C is also based on ecosystems but is covered separately in Section 5 because the identification process differs substantially from that used for Criteria A2 and B4.

4.1 Overview

KBA NCGs and KBA Proposers are encouraged to conduct a comprehensive scoping analysis (Steps 1-3 in Fig. 4.1) to identify all potential **trigger ecosystem types** and potential KBAs in the region of interest. Assessing **sites** against multiple criteria and **biodiversity elements** will strengthen the robustness of KBAs to changes in the status of particular **trigger biodiversity elements**.

The step-by-step process shown below serves to structure the guidelines and should be read as indicative. In practice, the process of KBA identification will likely vary among countries. Some KBA Proposers may wish to focus on identifying KBAs for a particular **ecosystem type** or determine whether a particular **site** qualifies as a KBA under Criterion A2 or B4.

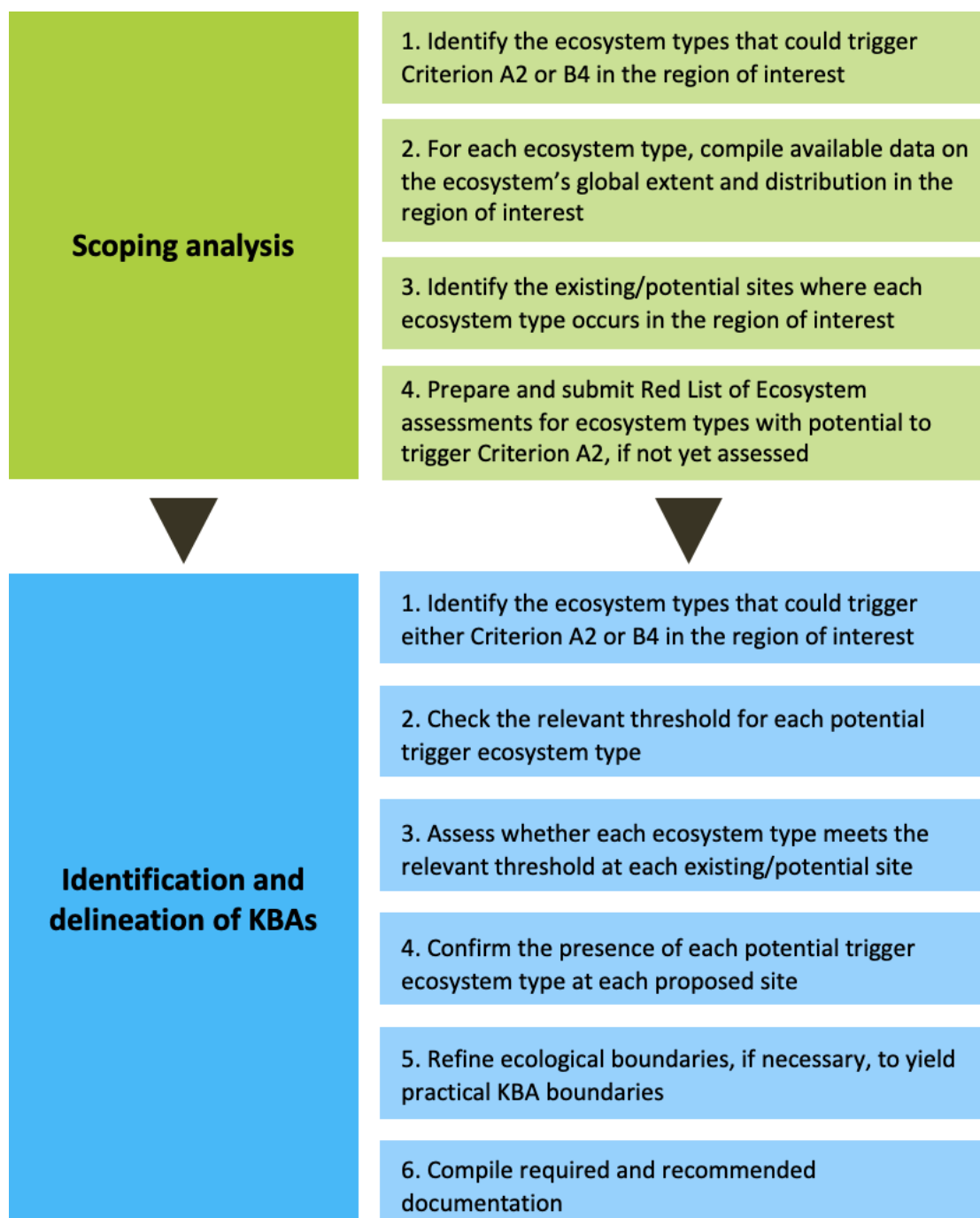


Figure 4.1 Overview of possible workflow for applying Criteria A2 and B4. *Source: Compiled by the KBA SAC.*

4.2 Scoping analysis for ecosystem-based criteria (A2, B4)

4.2.1 Identify the ecosystem types that could trigger Criterion A2 or B4 in the region of interest.

The *KBA Standard* (IUCN, 2016, pp. 17, 20) states that Criterion A2 and B4 should be applied to ecosystem types “at an intermediate level in a globally consistent ecosystem

classification hierarchy". The IUCN Global Ecosystem Typology provides a comprehensive classification framework for Earth's ecosystems based on their functional and compositional features (Figure 4.2; Table 4.2). In this hierarchy, biogeographic ecotypes (Level 4) and global ecosystem types (Level 5) are currently considered the relevant levels for KBA identification, but this needs to be confirmed through testing in multiple regions. In the meantime, KBA Proposers are requested to contact the KBA Secretariat for updates.

According to the IUCN Global Ecosystem Typology, biogeographic ecotypes (Level 4) are developed from the top down, by subdividing ecosystem functional groups (Level 3) using an ecoregional template (e.g., Spalding et al., 2007; Abell et al., 2008; Dinerstein et al., 2017). In contrast, global ecosystem types (Level 5) are derived from the bottom up, by aggregating sub-global ecosystem types (Level 6) based on compositional similarities. Sub-global ecosystem types are generally based on established local classifications (e.g., Mucina & Rutherford, 2006).

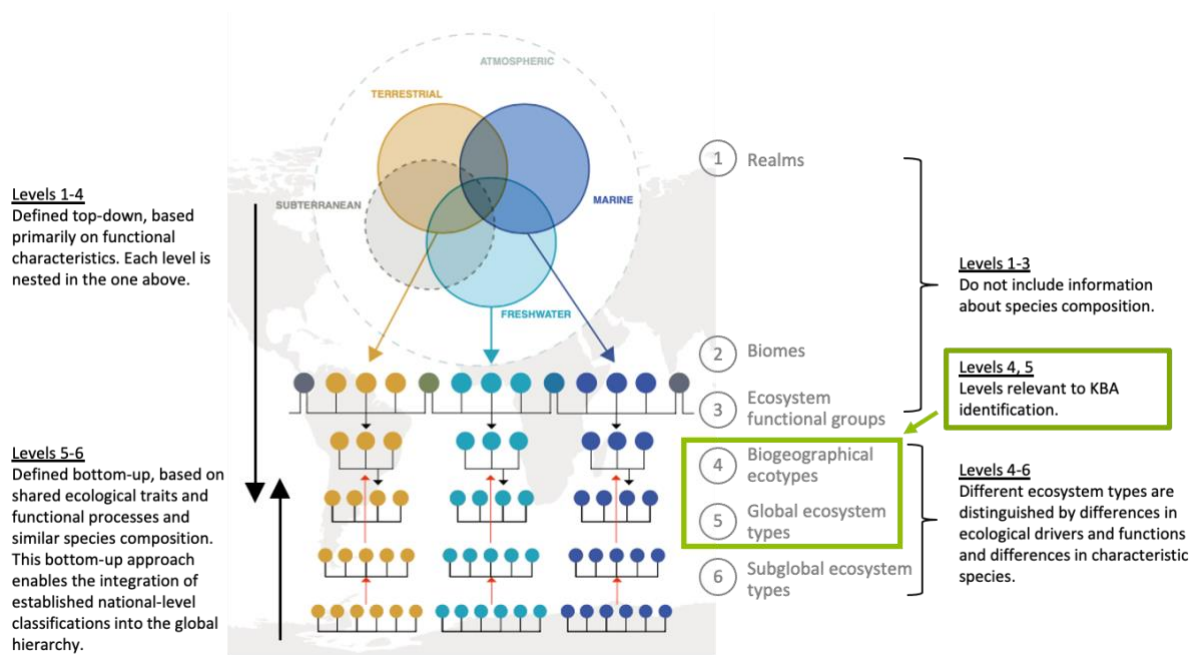


Figure 4.2 The IUCN Global Ecosystem Typology. *Source: Modified after IUCN Global Ecosystem Typology Ver. 2.0.*

Table 4.2 Ecosystem classification hierarchy used in the Red List of Ecosystems

Level	Definition
L1: Realm (e.g., Marine realm)	One of five major components of the biosphere that differ fundamentally in ecosystem organisation and function: terrestrial, freshwater, marine, subterranean, atmospheric.
L2: Functional Biome (e.g., Marine shelf biome)	A component of a realm united by one or a few common major ecological drivers that regulate major ecological functions. Biomes are derived from the top down by subdivision of realms (Level 1).
L3: Ecosystem Functional Group (e.g., Photic coral reefs)	A group of related ecosystems within a biome that share common ecological drivers promoting convergence of biotic traits that characterise the group. Function groups are derived from the top-down by subdivision of biomes (Level 2).
L4: Biogeographic ecotype (e.g., Western Madagascar coral reefs, as defined top-down by Obura et al. 2021)	An ecoregional expression of an ecosystem functional group derived from the top-down by subdivision of Ecosystem Functional Groups (Level 3). They are proxies for compositionally distinctive geographic variants that occupy different areas within the distribution of a functional group.
L5: Global ecosystem type (e.g., Coral reefs of South-West and West Madagascar, as defined in the Madagascar Red List of Ecosystems; Carré et al. 2020)	A complex of organisms and their associated physical environment within an area occupied by an Ecosystem Functional Group. Global ecosystem types grouped into the same Ecosystem Functional Group share similar ecological processes, but exhibit substantial difference in biotic composition. They are derived from the bottom up, either directly from ground observations or by aggregation of sub-global ecosystem types (Level 6).
L6: Subglobal ecosystem type	A subunit or nested group of subunits within a global ecosystem type, which therefore exhibit a greater degree of compositional homogeneity and resemblance to one another than global ecosystem types (Level 5). These represent units of established classifications, in some cases arranged in a sub-hierarchy of multiple levels, derived directly from ground observations.

Source: IUCN Global Ecosystem Typology Ver. 2.0

When applying [KBA Criteria A2 and B4](#), [KBA NCGs](#) or [KBA Proposers](#) may choose to use [biogeographic ecotypes](#) (Level 4), [global ecosystem types](#) (Level 5) or equivalent levels in a similar globally consistent ecosystem classification hierarchy (e.g., Macrogroup or Group in the EcoVeg hierarchy, Faber-Langendoen et al., 2014). Further guidance on appropriate levels in the [IUCN Global Ecosystem Typology](#) and on equivalent levels in similar globally consistent ecosystem classification hierarchies will be provided following testing in multiple regions (e.g., Comer et al., 2022 Appendix 3 links North American terrestrial ecosystems to Level 3 of the IUCN Global Ecosystem Typology).

Using [biogeographic ecotypes](#) (Level 4) will maximise global consistency as the [RLE Committee on Scientific Standards](#) plans to map and assess all [biogeographic ecotypes](#) using the [RLE Guidelines](#) (Bland et al., 2017) by 2025. The list of [biogeographic ecotypes](#) (Level 4) that may trigger Criterion A2 or B4 will be made available on the [Red List of Ecosystems](#) website.

In some countries, [global ecosystem types](#) (Level 5) may provide a more appropriate resolution and basis for [global KBA](#) identification. For Criterion A2, [global ecosystem types](#) will need to be assessed at the [global](#) level using the [RLE Guidelines](#) (Bland et al., 2017) and submitted for peer review and publication on the [Red List of Ecosystems](#). For Criteria A2 and B4, the [global extent of global ecosystem types](#) must be mapped before the relevant [threshold](#) can be applied. This may require international collaboration where [global ecosystem types](#) extend beyond national boundaries. The decision on which ecosystem classification and level to use should be made in consultation with the [KBA RFP](#) and [RLE Committee on Scientific Standards](#).

Can KBAs be identified for lower-level ecosystems?

As stated in the [KBA Standard](#) (IUCN, 2016), the [thresholds](#) associated with the ecosystem-based criteria (i.e. both A2 and B4) are designed to be applied at intermediate levels in a globally consistent ecosystem classification hierarchy (e.g., Levels 4 or 5 in Table 4.2.1). Lower-level [ecosystem types](#) (e.g., sub-global ecosystems types at Level 6 in Table 4.2.1) cannot trigger [global KBAs](#), pending further testing.

Can KBAs be identified for collapsed ecosystem types?

No – unlike species, ecosystems do not go extinct, but are transformed and replaced by different ecosystems (with different species, interactions, and ecological processes).

An [ecosystem type](#) is considered collapsed when its characteristic native species and other defining features are lost, or when species that perform key ecological roles are

greatly reduced in abundance and no longer able to maintain those functions. A collapsed **ecosystem type** cannot therefore trigger a KBA.

4.2.2 For each ecosystem type, compile available data on the ecosystem's global extent and distribution in the region of interest.

Spatial data showing the **extent** of **biogeographic ecotypes** (Level 4) will be made available through the **Red List of Ecosystems** website when these data are available.

For **global ecosystem types** (Level 5), **KBA Proposers** should follow the guidelines in Appendix IV on mapping the **extent** of **ecosystem types**. Note that the **global extent** of any **ecosystem types** used for KBA identification must be mapped; a national map is insufficient for **ecosystem types** that extend beyond national boundaries.

4.2.3 Identify the existing/potential sites where each ecosystem type occurs in the region of interest.

An **ecosystem/site** table may be developed by overlaying **site** boundaries on the distribution of each **ecosystem type** in a GIS. Boundaries of existing **KBAs**, other **sites** of importance for **biodiversity**, protected or conserved areas can be overlaid on spatial data for each **ecosystem type** to develop a list of existing **sites** where each **ecosystem type** occurs (see Section 7.1 for sources of GIS data on existing **sites**). GIS can be used to identify contiguous **ecosystem** areas that exceed **KBA thresholds** (i.e. 5%, 10% or 20% of the **global extent of an ecosystem type**) and have the potential to trigger Criterion A2 or B4.

If there are no suitable delineated **sites** in areas of potential importance, initial boundaries for potential **KBAs** may be based on ecological considerations (see Section 7.2). These boundaries may need to be refined later to yield practical **KBA** boundaries (see Section 7.3).

4.2.4 Prepare and submit Red List of Ecosystem assessments as appropriate.

Ideally, national-level assessments of potential **KBAs** against Criterion A2 will be based on a comprehensive assessment of all Level 4 or Level 5 **ecosystem types** in the country following the **RLE Guidelines** (Bland et al., 2017), as this will ensure a consistent ecosystem mapping and assessment approach and that threatened **ecosystem types** are not overlooked.

However, where a comprehensive assessment is not possible, **ecosystem types** that are likely to be threatened and have the potential to trigger a **KBA** under Criterion A2 may be prioritised for assessment using the **RLE Guidelines**.

4.3 Applying Criterion A2 to identify KBAs for threatened ecosystem types

4.3.1 Identify ecosystem types that could trigger Criterion A2 in the region of interest.

Ecosystem types at an intermediate level in a globally consistent ecosystem classification hierarchy (e.g., Levels 4 and 5 in Table 4.2) that have been assessed as globally threatened using the RLE Guidelines (Bland et al., 2017) can trigger KBA Criterion A2. Once the RLE Committee on Scientific Standards has completed global assessments of biogeographic ecotypes (Level 4), the list of biogeographic ecotypes that have been assessed as globally CR or EN or VU will be made available on the Red List of Ecosystems website. KBA NCGs or KBA Proposers interested in assessing global ecosystem types (Level 5) using the RLE Guidelines (Bland et al., 2017) should consult with the RLE Committee on Scientific Standards. Following peer review, completed assessments of global ecosystem types will be published on the Red List of Ecosystems website.

4.3.2. Check the relevant threshold for each potential trigger ecosystem type given its threat category.

A site qualifies as a KBA under Criterion A2 because it holds one or more of the following:

- a) $\geq 5\%$ of the global extent of a globally CR or EN ecosystem type;
- b) $\geq 10\%$ of the global extent of a globally VU ecosystem type.

How is the global extent of an ecosystem type defined?

In the context of KBA identification, the extent of an ecosystem type refers to its current global area of geographic distribution, representing all spatial occurrences of the ecosystem type including degraded occurrences (Bland et al., 2017, p. ix). KBA identification is based on geographic distribution maps, not the extent of ecosystem occurrence or the area occupied by the ecosystem (see Bland et al., 2017, p. 57 for comparison).

4.3.3 Assess whether each ecosystem type meets the relevant threshold at each existing/potential site given its threat category.

The percentage of the global extent of each globally threatened ecosystem type that lies within each existing/potential site's boundaries can be compared to the relevant threshold for the ecosystem type given its threat category (see Table 4.3 for example). This calculation will be checked in the WDKBA when it is fully functional.

Table 4.3 Example of KBA assessment using Criteria A2 or B4 taking Red List of Ecosystems category into account. Cells that trigger qualification of sites as KBAs under Criterion A2 or B4 are highlighted.

	Red List of Ecosystems category	Criterion	Threshold (%)	Global extent	Ecosystem extent (km ²)				
					Threshold	Site 1	Site 2	Site 3	Site 4
Criterion A2:									
Ecosystem type 1	CR	A2a	5%	2,000	100	500			
Ecosystem type 2	EN	A2a	5%	20,000	1,000		5	1,500	
Ecosystem type 3	VU	A2b	10%	20,000	2,000	1,500		1,000	4,000
Criterion B4:									
Ecosystem type 5		B4	20%	2,000	400	500			
Ecosystem type 6		B4	20%	20,000	4,000		500	1,500	
Ecosystem type 7		B4	20%	20,000	4,000	1,500		1,000	4,000

Source: Compiled by the KBA SAC.

Can the proportion of the global ecosystem extent at a site be rounded up?

No – estimates of the proportion of the global ecosystem extent at a site should not be rounded up, as that would have the effect of reducing the threshold.

4.3.4 Confirm the presence of each potential trigger ecosystem type at each proposed site.

The final step in assessing a **site** against **KBA** Criterion A2 or B4 is to confirm the presence of the potential **trigger ecosystem type** at the **site**.

How is the presence of an ecosystem at a site confirmed?

Most ecosystems are relatively stationary, at least in the 8-12 year timeframe for **KBA** reassessment. For **biogeographic ecotypes** (Level 4) and **global ecosystem types** (Level 5) that have recently been assessed for the **Red List of Ecosystems**, the associated geographic distribution maps may be used as confirmation of presence, unless it is likely that the distribution has changed since the map was developed (e.g., through recent ecosystem-transforming fires or landcover conversion).

If it is likely that distribution changes have occurred since the most recent geographic distribution map, **KBA Proposers** should overlay this map on recent high-resolution satellite imagery to reconfirm presence of the **ecosystem type** within the proposed **KBA** boundaries. In the case of a forest **ecosystem type**, for example, **KBA Proposers** should confirm that the forest **ecosystem type** is still present within the **KBA** and has not been destroyed by fire or converted to other types of landcover, such as pasture or crops. This can often be done using open-access tools such as **Google Earth**. More subtle distinctions or transformations, such the degradation of arid shrublands by overgrazing, may require targeted field-based sampling or other recent documentation.

4.3.5 Refine ecological boundaries, if necessary, to yield practical KBA boundaries.

KBA delineation is not complete until ecological boundaries have been evaluated and refined, if necessary, to yield a **manageable site** or **sites** (see Section 7.3 for further guidelines).

4.3.6 Compile required and recommended documentation.

See the **KBA Proposal Process guidance** for required and recommended documentation for Criterion A2 or B4.

4.4 Applying Criterion B4 to identify KBAs for geographically restricted ecosystem types

4.4.1 Identify ecosystem types that could trigger Criterion B4 in the region of interest.

How are geographically restricted ecosystem types identified for the purposes of applying KBA Criterion B4?

The definition of **geographically restricted** given in the **KBA Standard** (IUCN, 2016) is indicative rather than prescriptive. For the purpose of identifying **KBAs** under Criterion B4, an **ecosystem type** is considered **geographically restricted** if there is at least one **site** that holds $\geq 20\%$ of the **global extent** of the **ecosystem type**.

4.4.2. The B4 threshold is 20% for all ecosystem types.

A **site** qualifies as a **KBA** under Criterion B4 because it holds $\geq 20\%$ of the **global extent** of an **ecosystem type**, regardless of whether the **ecosystem type** is **globally threatened**.

How is the global extent of an ecosystem type defined?

See Section 4.3.2.

4.4.3 Assess whether each ecosystem type meets the B4 threshold at each existing/potential site.

See Section 4.3.3.

4.4.4 Confirm the presence of each potential ecosystem type at each proposed site.

See Section 4.3.4.

For **biogeographic ecotypes** (Level 4) or **global ecosystem types** (Level 5) that have not recently been assessed, a validated geographic distribution map developed in the last 8-12 years may be used as confirmation of presence, unless it is likely that the distribution has changed since the map was developed.

4.4.5 Refine ecological boundaries, if necessary, to yield practical KBA boundaries.

See Section 4.3.5.

4.4.6 Compile required and recommended documentation.

See Section 4.3.6.

5. Identifying Key Biodiversity Areas based on ecological integrity (Criterion C)

Sites qualifying as KBAs under Criterion C represent examples of outstanding ecological integrity at the global scale.

5.1 Defining ecological integrity

How is ecological integrity defined?

The KBA Standard defines ecological integrity as “A condition that supports intact species assemblages and ecological processes in their natural state, relative to an appropriate historical benchmark, and characterised by contiguous natural habitat with minimal direct industrial anthropogenic disturbance” (IUCN, 2016, p. 12), where intact species assemblages or intact ecological communities have “the complete complement of species known or expected to occur in a particular site or ecosystem, relative to a regionally appropriate historical benchmark, which will often correspond to pre-industrial times” (IUCN, 2016, p. 13).

Following a workshop convened by the KBA Standards and Appeals Committee, KBA Technical Working Group and KBA Secretariat to review lessons learned from application of Criterion C in November 2021, the KBA Standards and Appeals Committee determined that the intent of the KBA Standard would be supported by considering a broad interpretation of ecological integrity, incorporating ecosystem structure, function and composition as established in the scientific literature (e.g., Noss, 1990, Woodley, 2010, Nicholson et al., 2021). The KBA Guidelines (Ver. 1.2) therefore recognise the following interpretation of ecological integrity for the purposes of applying Criterion C:

Ecological integrity (Criterion C): The degree to which an ecosystem’s observed structure, function and composition resemble those characteristic of regionally appropriate historical benchmarks or other high-integrity reference states that support ecosystem and biodiversity persistence and are minimally impaired by threatening processes.

The ecological integrity of a site is a function of its component ecosystems and their collective ecological integrity. When assessing ecological integrity, it is therefore important to recognise that the composition of natural ecosystems may be dynamic

on multiple spatial and temporal scales, especially in the context of global climate change, and that the contribution of species to ecosystem function is diverse.

Key terms used in this working interpretation of **ecological integrity** include:

High-integrity reference states are used to identify ecological attributes and indicators of ecosystem *structure, function* and *composition* within the expected range of variation characteristic of the geographic location in ecosystems with outstanding **ecological integrity**. *High-integrity reference states* may be derived from regionally appropriate historical baselines, replicated contemporary ecosystem samples, ecosystem models and/or expert judgement (see further detail below).

Degree: **Ecological integrity** is not binary – a particular sample of an ecosystem may lie anywhere along a spectrum from outstanding **ecological integrity** to collapsed. **Sites** qualifying as **KBAs** under Criterion C are demonstrated to be examples of globally outstanding **ecological integrity**.

Composition: Encompasses the identity and variety of the biota, and includes characteristics of species **assemblages** such as diversity and abundance/ biomass across taxonomic groups and trophic levels.

Structure: Relates to physical organisation, including structural connectivity, contiguity of natural habitat, vertical and horizontal spatial arrangement of the biota, substrate characteristics, and size- or age-class distributions.

Function: Refers to the functioning of ecological processes, such as nutrient-cycling, productivity, pollination, seed dispersal, predator–prey interactions, functional connectivity (including species movement, dispersal and metapopulation dynamics, and exchanges between ecosystems), phenology, disturbance regimes (e.g., fire and drought) and hydrological processes.

How are high-integrity reference states defined?

High-integrity reference states should be defined in a way that is consistent with identifying only those **sites** that represent examples of globally outstanding **ecological integrity**.

There are a range of options for defining *high-integrity reference states*, all of which depend on some combination of ecological theory, empirical data, Indigenous and Local Knowledge and other expert judgement, including one or more of the following:

- *Historical benchmarks* – These are the initial states for assessing change over specified timeframes (e.g., since the industrial era). The choice of historical baseline

should be accompanied by an explanation of why it is appropriate to the region (see Stephenson et al., (2019) for discussion), taking into account the history of Indigenous land management in the region. Historical benchmarks will be less relevant in regions that have been significantly impacted by global climate change.

There are many methods for developing historical reconstructions that can be used to establish *high-integrity reference states*. For example, long-term fire histories can be created from fire scars in forested ecosystems, indicating the range of historical variation; other examples include the use of pollen cores from lakes.

- *Replicated contemporary samples (or reference sites)* – *High-integrity reference states* may be based on replicated contemporary samples of the ecosystem type exposed to minimal impacts from threatening processes or drivers (e.g., industrial agriculture, mining, timber harvest, fishing, invasive species, fire suppression).
- *Modelling* – Conceptual or quantitative ecosystem models that describe the expected values of key ecosystem features, processes and interactions are a useful way to define reference states. Ecosystem models that describe the expected state of the ecosystem under current climate conditions, but without other industrial human impacts, are especially useful for defining *high-integrity reference states* (c.f. Rodrigues et al., 2019). At a species level, quantitative population viability models or model-based estimates of carrying capacity can be useful for defining the expected range of variation in population size or abundance of functional indicator species in ecosystems with outstanding [ecological integrity](#).
- *Biological patterns* – Ecosystems have characteristic biological patterns for metrics such as food webs. For example food chain length is a fundamental ecosystem property, and plays a central role in determining ecosystem functioning (Vander Zanden and Fetzer, 2007; Saporiti et al., 2015) Observed food webs can be compared to the expected characteristics of food webs in a particular geographic location, which serve as a *high-integrity reference state*.
- *Long-term datasets* – Long-term datasets relating to ecosystem *structure, function and/or composition* are available for some ecosystems (e.g., including data on primary production, nutrient-cycling, species abundance and distribution, and disturbance patterns; Vanderbilt & Gaiser, 2017). These long-term datasets can be used to establish high-integrity reference states.
- *Expert judgement* – Expert judgement can be used where data are limited or conflicting, using established methods such as structured expert decision-making (e.g., Hemming et al., 2018).

- *Indigenous and Local Knowledge* – Indigenous and Local Knowledge, including knowledge of particular ecosystems or sites, can be used to establish or verify *high-integrity reference states*, following protocols of the accession and use of such knowledge.

5.2 Applying Criterion C to identify KBAs with outstanding ecological integrity

A site qualifies as a KBA under Criterion C because it is “one of ≤2 per ecoregion characterised by wholly intact ecological communities, comprising the composition and abundance of native species and their interactions” (IUCN, 2016, p. 21).

Ecoregions provide the basis for assessment of Criterion C. An **ecoregion** is a “relatively large unit of land (or water) containing a distinct **assemblage** of natural communities and species with boundaries that approximate the original extent of natural communities prior to major land-use change” (Olson et al., 2001; IUCN, 2016, p. 12; please see Appendix V for ecoregion templates for terrestrial, freshwater and marine systems.) Nevertheless, delineation of Criterion C KBAs should not be overly constrained by **ecoregion** boundaries (see Section 5.3.2 for further discussion). Some **ecoregions** do not have any remaining areas with the outstanding **ecological integrity** required to qualify as a **KBA** under Criterion C.

The **KBA Standard** states that **ecological integrity** should be observed or inferred from evidence based on both:

- absence (or very low levels) of direct industrial human impact, as quantified by appropriate indices at the scale of interest and verified on the ground or in the water;

AND

- direct measures of species composition and abundance/ biomass/ density across **taxonomic groups** (particularly for species indicative of long-term structural stability and functionality or those known to be highly sensitive to human impact).

The guidelines below outline a practical approach for identifying sites of outstanding **ecological integrity**.

Identifying sites qualifying as KBAs under Criterion C in practice

Criterion C identifies **sites** of globally outstanding **ecological integrity**, with observed or inferred ecosystem *structure, function and composition* measured relative to

regionally appropriate historical benchmarks or other *high-integrity reference states* that support ecosystem and biodiversity persistence, within the range of natural variability characteristic of the geographic location and with minimal impacts from threatening processes including industrial human activities.

KBAs qualifying under Criterion C:

- maintain fully functional ecosystem types and their components, and should be large enough to maintain ecological communities through most natural disturbance events and sustain most broad-scale ecological processes over the long-term (Janzen, 1986; Newmark et al., 1995; Balmford et al., 1998; Scott et al., 1999; Laurance et al., 2002; Leroux et al., 2007; Woodley, 2010; IUCN & WCPA, 2017).
- are characterised by contiguous or near-continuous natural communities and functioning broad-scale ecological processes (e.g., wildfire, free-flowing rivers, and flooding patterns) and the natural movement patterns of species.
- maintain diagnostic components of their characteristic native biota (defined in Section 5.4.0), including species indicative of long-term structural stability and functionality at levels of abundance or biomass sufficient to maintain key ecological functions (Soulé et al., 2003).
- are still natural, requiring no or very limited human intervention to maintain ecosystem *structure, function* and *composition* and support ecosystem and biodiversity persistence, apart from traditional Indigenous management and actions to prevent incursions of threatening processes (e.g., invasive species, industrial development).
- are substantially undisturbed by significant direct industrial human influence, as shown by appropriate indicators including the continued presence of species known to be highly sensitive to human impacts.

Ecological integrity is a multidimensional concept that cannot be assessed using a single ecological attribute or indicator. Sites qualifying as **KBAs** under Criterion C may be identified using the *ecological integrity attributes* and *indicators* detailed below in Section 5.4.0. These capture the intent of the KBA Standard regarding community *composition*, while incorporating additional elements of ecosystem *structure* and *function* and providing greater flexibility to accommodate natural ecosystem dynamics.

5.3 Scoping analysis to identify areas with potential to trigger Criterion C

5.3.1 Conducting scoping analysis to identify areas with potential to trigger Criterion C

In many cases, it will be useful to identify Criterion C KBAs through a step-based process, beginning with regional scoping analysis to filter out areas with limited potential or identify areas with high potential, followed by site evaluation and selection within ecoregions (Fig. 5.3.1).

Scoping analysis is optional, but is expected to be useful in any process to identify Criterion C KBAs across large regions with many possible options. Most Criterion C identification processes have taken a sequential approach, focusing on direct industrial human impact pressures (e.g., infrastructure) during scoping analysis and other elements during site evaluation.

KBA Proposers are urged to pay particular attention to balancing omission and commission errors. It is generally better to be inclusive rather than exclusive at this stage (i.e. allow some candidate areas with lower ecological integrity to slip through the preliminary scoping filter to ensure that areas with high ecological integrity are not inadvertently discarded by an overly stringent filter). Some candidate areas that pass the initial scoping filter will not be proposed as Criterion C sites following site evaluation (see Section 5.4.1); whereas some potential sites that do not fall within initial candidate areas may be reconsidered later, if subsequent expert consultations indicate that was an error.

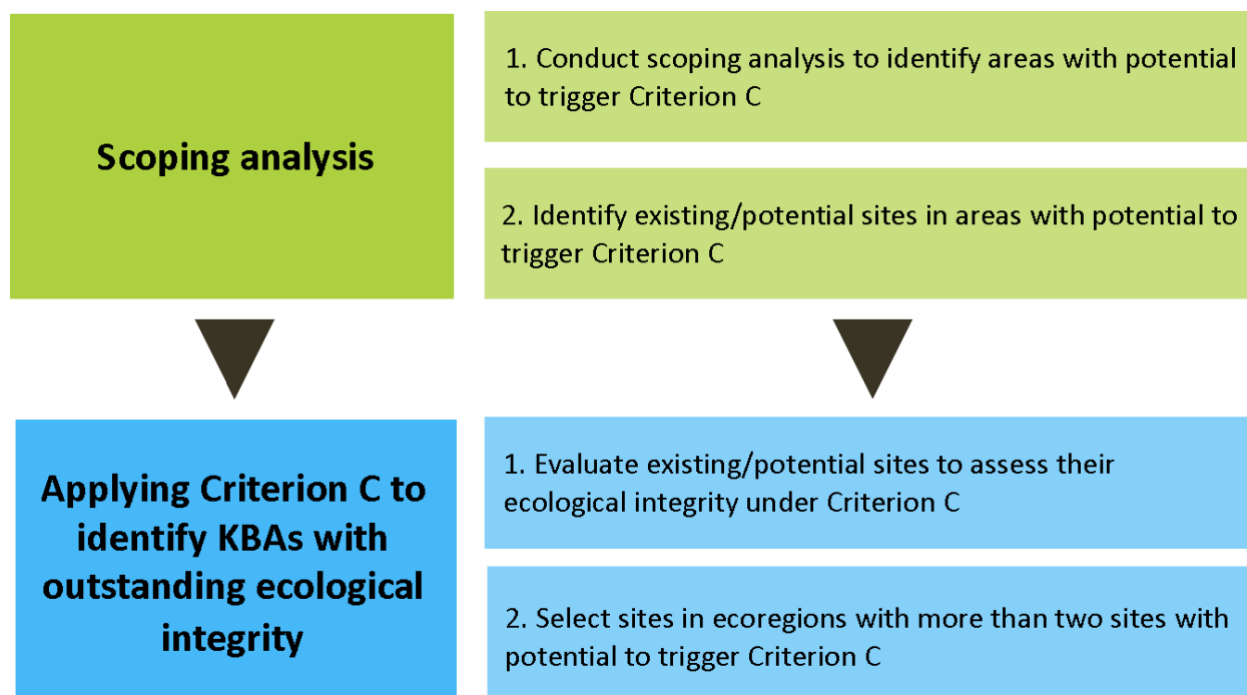


Figure 5.3.1 Overview of possible workflow for applying Criterion C. *Source: Compiled by the KBA SAC.*

How is absence (or very low levels) of human impact measured?

Absence, or very low levels, of direct industrial human impact does not necessarily mean absence, or even low densities, of human inhabitants. For example, many [sites](#) with outstanding [ecological integrity](#) have been inhabited by Indigenous peoples for millennia. Conversely, some areas with very low human population densities have undergone extensive loss of [ecological integrity](#) through human-induced pressures (e.g., over-exploitation, invasive species, alteration of hydrological processes and natural disturbance processes).

Rather, for a [site](#) to qualify as a [KBA](#) under Criterion C, human impacts must not have eroded [ecological integrity](#). The focus should therefore be on pressures that are likely to have significant impacts on *structure, function* and *composition* in the ecosystems of interest. Spatial indices that integrate information on pressures and impacts can be especially useful in this context (e.g., the Forest Landscape Integrity Index, which integrates information on observed and inferred human pressures and lost forest connectivity, Grantham et al., 2020).

Preliminary analyses may be based on readily available global and/ or preferably regional-level cumulative human pressure datasets (e.g., roads and infrastructure; Sanderson et al., 2002; Venter et al., 2016; Poley et al., 2022).

Understanding the key drivers of change within an **ecoregion** or area of interest can help to identify the most appropriate factors and datasets for identifying areas with low levels of human impacts. **KBA Proposers** are encouraged to refer to summaries of the main threats currently affecting or likely to affect relevant ecosystems in existing ecoregional assessments and **Red List of Ecosystems** assessments where available.

KBA Proposers may develop quantitative indices based on cumulative human pressure datasets to filter out areas with significant direct industrial human impacts. In regions where drivers of change are similar across adjacent **ecoregions**, the same indices may serve for multiple **ecoregions**. Elsewhere, **ecoregion**-specific indices of human impact will likely be more appropriate, especially where more detailed or up-to-date information is available at the **ecoregional** level than at broader scales.

Thresholds should be set at regional or **ecoregional** levels, with reference to the impacts of pressures on the **ecological integrity** attributes listed below. Sensitivity analysis should be conducted around thresholds. In all **ecoregions**, the aim is to identify **sites** that represent examples of outstanding **ecological integrity**, but the same type of infrastructure can have different levels of impact in different regions. Roads, for example, can have limited impacts on **ecological integrity** in some regions, but lead to broad-scale logging, mining and hunting in others.

Pervasive global-scale threats that affect all marine and/or terrestrial areas (e.g., climate change, ocean acidification, past overharvest of cetaceans) should not be included as binary factors in this analysis (i.e. as simple yes/no layers), as no **site** would be identifiable under Criterion C in that case. However, they may be useful as relative factors, highlighting areas where the impact on **ecological integrity** is relatively high, moderate or low, for example.

5.3.2 Identifying existing/potential sites in areas with potential to trigger Criterion C

Some large existing **KBAs** and other **sites** of importance for **biodiversity** (see Section 7.1) may qualify under Criterion C. However, scoping analysis may also reveal areas of potential importance where there are no existing **KBAs**, other recognised **sites** of importance for **biodiversity**, or protected or conserved areas. In these areas, initial boundaries for potential **KBAs** may be based on ecological considerations (see Section 7.2). In some **ecoregions**, initial **KBA** boundaries will be clear because areas with **ecological integrity** are bounded by areas that clearly do not qualify. In terrestrial **ecoregions** without other clear ecological boundaries, watersheds can provide a useful tool for deriving initial **site** boundaries at an appropriate spatial scale. (See Section

7.3.3 for guidance in this context.) Initial boundaries may need to be refined later to yield practical **KBA** boundaries (see Section 7.3).

Are KBA Criterion C sites required to be at least 10,000 km²?

Sites generally need to be large to maintain **ecological integrity** without significant management intervention. The **KBA Standard** states that “**KBAs** identified under Criterion C should ideally be delineated to be at least 10,000 km² in size, within the confines of **manageability**...” (IUCN, 2016, p. 21). However, this is not integral to the Criterion C threshold and should be interpreted as a recommendation rather than a requirement. **Sites** that are less than 10,000 km² in size may therefore be proposed as **KBAs** under Criterion C. Criterion C **KBAs** may extend beyond **ecoregion** boundaries (see below in this section), so the size of individual **ecoregions** does not represent a constraint. However, the requirement that all **KBAs** should be **manageable** as a unit may constrain the upper size limit of Criterion C **KBAs**.

The ecological and social characteristics of the area in question (including Indigenous governance) will determine the appropriate scale of potential **sites** and should be described by **KBA Proposers**. **Sites** should be large enough to match the description of **KBAs** qualifying under Criterion C in Section 5.2 above. See also the concept of minimum dynamic area (Pickett & Thompson, 1978; Leroux et al., 2007; and the IUCN Green List of Protected and Conserved Areas, IUCN & WCPA, 2017). In some regions, **sites** larger than 10,000 km² will be required to accommodate broad-scale processes such as fire regimes and species migrations. Conversely, smaller **sites** may be appropriate for isolated islands or island-like features (e.g., isolated physical features) that maintain fully functional ecosystem types and their components.

What does “within the confines of manageability” mean in the context of Criterion C?

The concept of **manageability** may be somewhat different in the context of **sites** identified as **KBAs** for their **ecological integrity** under Criterion C from **sites** identified as **KBAs** under other criteria (e.g., a site identified for a CR species under subcriterion A1e). Generally, managing for **ecological integrity** will require a less intensive approach to *in situ* management, with the exception of addressing direct threats to ecological integrity (e.g., control of invasive species, barrier removal). This implies that the scale of **manageability** is potentially much larger in the context of Criterion C than for other **KBAs**.

Can a Criterion C site encompass parts of more than one ecoregion?

Yes. In many cases, **sites** with outstanding **ecological integrity** do not fit neatly within the boundaries of **ecoregions**. Global **ecoregion** boundaries are approximations and do not necessarily align with ecological features relevant to **site** delineation. Broad-scale ecological processes, including the natural movement patterns of area-demanding species and natural disturbance regimes, often extend across **ecoregion** boundaries.

Delineation of Criterion C **KBAs** should not be overly constrained by **ecoregion** boundaries. Delineating **sites** that include more than one **ecoregion** may be especially appropriate in regions with relatively small **ecoregions**. The **KBA Standard** states that, “where **sites** straddle ecoregional boundaries, delineation should proceed without respect to ecoregional division” (IUCN, 2016, p. 21).

Some well delineated Criterion C **KBAs** may include one or more primary **ecoregions** and small segments of other **ecoregions**. For **sites** that encompass parts of more than one **ecoregion**, **KBA Proposers** should specify which **ecoregion(s)** the **site** is representing (see Section 5.4.2 for more details).

Can Criterion C KBAs be identified for ecoregions that straddle national boundaries?

Yes — many **ecoregions** straddle national boundaries. In this context, collaboration between **KBA NCGs** and **KBA Proposers** in neighbouring countries is recommended to ensure a consistent approach to **site** evaluation under Criterion C (including factors used in scoping analysis and *ecological integrity attributes* and *indicators* used in site evaluation) and agreement on up to two main **sites** per **ecoregion** to propose as **KBAs** under Criterion C, including possible transboundary sites.

5.4 Applying Criterion C to identify KBAs with outstanding ecological integrity

5.4.0 Ecological integrity attributes and indicators

Ecosystems are complex and dynamic, changing due to both natural processes and anthropogenic changes compounded by climate change. **Ecological integrity** must be evaluated in this context. A **site** with outstanding **ecological integrity** can be identified by demonstrating that the main ecosystems found at the **site** are consistent with regionally appropriate historical benchmarks or other *high-integrity reference states*, using a suite of *ecological integrity attributes* and *indicators* (Box 5.4.0) that capture the multiple dimensions of **ecological integrity** (i.e. ecosystem *structure, function* and

composition and *anthropogenic stress* on the ecosystem). Given the complexity of ecological integrity, the set of practical measures will be based on proxies for ecological integrity.

Box 5.4.0. Key terms for measuring ecological integrity¹⁵

Ecological integrity attributes – key aspects of an ecosystem’s *structure, function* or *composition* that support ecosystem and biodiversity persistence

Indicator – measurable entity that is used to assess the status of an *ecological integrity attribute*

Range of variation – the expected range of variation in an *indicator* that is consistent with outstanding **ecological integrity**

KBA NCGs and KBA Proposers should aim to develop a comprehensive set of *ecological integrity attributes* and *indicators* capturing *structure, function, composition* and *anthropogenic stress* (see below). Different *indicators* will likely be needed for the main ecosystems within a site. KBA Proposers are encouraged to refer to descriptions of the characteristic native biota and key ecological processes and interactions of relevant ecosystems in existing ecoregional assessments and Red List of Ecosystems assessments where available. Conceptual models of key ecosystem dynamics, such as those developed as part of Red List of Ecosystems assessments, can also provide a useful reference (see Bland et al., 2017).

For each selected *indicator*, the next step is to define the expected *range of variation* in ecosystems with outstanding **ecological integrity**, consistent with *high-integrity reference states*. Given that natural ecosystems are dynamic, assessments of **ecological integrity** should take into account the expected *range of variation* in ecosystem *structure, function* and *composition* under natural environmental conditions and phases of natural disturbance (e.g., a **site** in a fire-adapted ecosystem should not be excluded because it has relatively few fire-intolerant seedlings immediately following a natural fire).

The final decision on whether a site qualifies as an example of outstanding **ecological integrity** at the **global** scale should be based on a weight-of-evidence approach applied

¹⁵ Adapted from The Nature Conservancy (2003) Assessment of Target Viability1 Worksheet: Conservation Project Management Workbook Versions 3 (CAP) and 4. The Nature Conservancy, Arlington, Virginia USA.

to the *ecological integrity attributes and indicators* identified below. Expert judgement can play an important role in assessing *ecological integrity attributes and indicators* where suitable quantitative or qualitative data are not available.

Ecological integrity attributes and indicators

Ecological integrity attributes that can be adapted for all ecosystems can be identified using the following questions. *Ecological integrity attributes* and associated *indicators* should be identified and assessed for all questions for which reliable data are available. Attributes are not independent of each other.

1. *Functional indicator species*: Are functional indicator species within acceptable population ranges? (*Function*)

This *ecological integrity attribute* focuses on the functional components of the characteristic native biota (i.e. the species that are central in driving ecosystem dynamics and function, such as ecosystem engineers, trophic or structural dominants, or functionally unique elements, Bland et al., 2017). The set of functional indicator species should ideally include species from multiple taxonomic groups with diverse ecological functions and ideally collectively serve as indicators for *structure, function, composition* and *anthropogenic stress*, including:

- species indicative of long-term structural stability and that underpin key ecosystem functions (e.g., old structure-forming plants, top predators, other keystone species, ecosystem engineers and foundation species, seed-dispersers and pollinators; Paine, 1969; Dayton, 1972; Jones et al., 1994);
- species sensitive to broad-scale ecological processes (e.g., fire, flood, grazing and predation; Carignan & Villard, 2002);
- area-demanding species (e.g., low density and highly mobile species; Boyd et al., 2008; Didier et al., 2009);

The set of functional indicator species should be accompanied by an explanation of why such species are appropriate and relevant for inferring ecosystem integrity. It will often be useful to construct simple foodweb or ecosystem models to identify functional components of the characteristic native biota and help select functional indicator species at various trophic levels. If a species has a high number of web connections or a large proportion of the total energy in the foodweb flows through that species, its loss would impact the ecosystem's integrity. If the loss of a species would significantly alter ecosystem function, then it should be included in the set of functional indicator species.

Sites with outstanding **ecological integrity** should contain functional indicator species at ecologically functional densities (Soulé et al., 2003). Shifts in the relative abundance of functional indicator species are symptoms of change in ecosystem behaviour and identity (Bland et al., 2017; see Table 8 for examples). *Indicators* for this *ecological integrity attribute* should therefore ideally capture the relative abundance or biomass of functional indicator species, using measures that can be assessed quantitatively, qualitatively or through expert judgement.

2. *Characteristic native species*: Has the system lost characteristic native species? (*Composition*)

Assessments of species composition are essential for the identification of **KBAs** that qualify under Criterion C. Systems under stress tend to lose native species, and declines in species richness may lead to loss of ecosystem function and resilience (see Bland et al., 2017, Table 8 for examples). Nevertheless, it is recognised that comprehensive species inventories covering all taxonomic groups are impossible in most regions of the world, especially remote **ecoregions** with few human settlements and limited road access.

This *ecological integrity attribute* therefore focuses on the diagnostic components of the characteristic native biota, i.e. the native species that define the identity of an **ecosystem type** and distinguish it from other **ecosystem types**. For example, raised bogs in Germany are characterised by vegetation dominated by peat mosses (e.g., *Sphagnum magellanicum*, *Sphagnum fuscum*) and insectivorous plants like sundew (*Drosera* spp.); dominance by peat mosses, together with geomorphic and hydrological processes, distinguishes raised bogs from other **ecosystem types** (see Bland et al., 2017, Box 3, for this and other examples). Loss of these species may lead to significant alterations in ecosystem *structure, function, composition* or ecosystem identity; the significance of a species' loss should be considered in this context.

Indicators for this *ecological integrity attribute* can be derived from the list of species representing the diagnostic component of the characteristic native biota of ecosystems at the **site**. Preliminary scoping of areas that retain their characteristic native biota may be informed by regional maps showing areas where species have been extirpated if reliable data are available at appropriate scales. However, **site** evaluation will often involve workshops or interviews with **biodiversity** knowledge-holders and possibly new field surveys to ground-truth regional datasets (see Section 5.4.1).

3. *Natural movement patterns*: Are species able to engage in natural movement patterns? (*Structure*)

Sites qualifying as **KBAs** under Criterion C should be large enough, with contiguous natural habitat, to enable species to engage in natural movement patterns unimpeded by artificial barriers (e.g., veterinary fences). Natural movement patterns include those of highly mobile migratory and nomadic species (e.g., migratory ungulates) as well as more localised movements between ecosystems (see Bland et al., 2017, Table 8 for examples).

Indicators for this *ecological integrity attribute* may include maps indicating the movement patterns of species with broad-scale natural movement patterns.

4. *Harmful invasive species*: Has the system gained non-native species with significant impacts on ecosystem structure, function or composition? (*Composition*)

Here, the focus is on harmful invasive species that have significant impacts on ecosystem *structure, function* or *composition*. Harmful invasive species may alter ecological communities through predation or competitive exclusion or by making habitat unsuitable for the persistence of some native biota. The **Guidelines for using the IUCN Environmental Impact Classification for Alien Taxa (EICAT) Categories and Criteria** describe harmful alien taxa as those that are known to be having deleterious impacts upon native biodiversity at the level of the organisation of ecological communities (e.g., through population declines and local population extinctions). The significance of non-native species should be considered in the context of their impacts on ecosystem *structure, function* or *composition*; they do not need to have been assessed using the **EICAT Guidelines** to be considered relevant here. (See also Bland et al., 2017, Table 8, for relevant examples.)

Indicators for this *ecological integrity attribute* should be based on the expected impacts of transformer invasive species known or likely to occur at the **site**. (For example, in some deciduous forest ecosystems, unusually large stands of dead trees are indicative of invasive pest outbreaks.)

5. *Trophic levels*: Has trophic structure been significantly altered or simplified? (*Structure*)

This *ecological integrity attribute* focuses on foodweb structure, including the number of trophic levels and interactions among them. Stressed ecosystems show changes in trophic structure, often signalled by the loss or reduction of large or specialised predators. Changes in trophic structure may precipitate species loss or reductions in

abundance at multiple trophic levels (for example, over-exploitation of upper trophic levels may lead to simplification of lower trophic levels) with consequences for ecosystem function and composition (see Bland et al., 2017, Table 8 for examples).

Indicators for this *ecological integrity attribute* may be derived from simple foodweb diagrams or more complex ecosystem models (e.g., Ecopath models; NOAA, 2007) .

6. *Ecosystem configuration*: Does the physical organisation of ecosystem types support native biodiversity? (*Structure*)

This *ecological integrity attribute* focuses on the physical organisation of ecosystem types in forests, woodlands, savanna, reefs, kelp forests etc. This refers to the arrangement of ecosystem types, ecosystem states and recurrent ecosystem patterns.

At a given site, disturbance regimes, such as fire, flooding, drought, storms and disease, create a mosaic of ecosystem types, with characteristic juxtaposition or recurring pattern. The resulting configuration of community types is essential for biodiversity persistence.

Indicators for this *ecological integrity attribute* include cover, adjacency, patch size, connectivity, fragmentation, and the vertical and horizontal spatial arrangement of biotic habitat, as well as size distributions. For terrestrial ecosystems, several of these *indicators* can be assessed using remotely sensed data.

7. *Productivity*: Is the productivity of the system operating within limits that support the system? (*Function*)

This *ecological integrity attribute* focuses on the productivity needed to maintain ecosystem function. Ecosystems are driven by primary productivity, the amount of organic matter produced by biological activity per unit area in a given time period. Productivity and decomposition operate within a range for specific ecosystems. When these vital processes move outside that range, the ecosystem may be fundamentally altered. Primary productivity in marine and terrestrial systems has been measured by remote sensing for several decades. Long-term movement away from the mean annual productivity at a [site](#) is generally indicative of ecosystem transformation (e.g., a decrease in primary productivity is a key indicator for land degradation).

Indicators for this *ecological integrity attribute* measure the expected range of variation in primary productivity in ecosystems with outstanding [ecological integrity](#).

8. *Broad-scale physical processes*: Are key physical processes supporting biodiversity? (Function)

This *ecological integrity attribute* focuses on broad-scale ecological processes, specifically key physical or abiotic processes that are not captured by other *indicators*. Ecosystems are inherently dynamic, driven by processes such as fire, flooding, drought and storms. After disturbance, ecosystems pass through sometimes-predictable successional stages and biodiversity is adapted to those disturbance regimes. Long-term changes in disturbance regimes can lead to ecosystem transformation. Thus, an understanding of the ecological processes that sustain ecosystems and biodiversity at a site can be important for assessing *ecological integrity*.

Indicators for this *ecological integrity attribute* will be specific to each physical process (e.g., frequency and spatial extent of fire or flooding events) and should capture the expected range of variation in ecosystems with outstanding *ecological integrity*.

9. *Anthropogenic stress*: Are anthropogenic pressures leading to significant alterations in ecosystem structure, function or composition? (*Anthropogenic stress*)

Here, the focus is on identifying any anthropogenic pressures that are major drivers of changes in ecosystem *structure, function* and/or *composition* at the *site*. Examples include reduced abundance in mid-trophic level fish biomass through unsustainable fishing, significant changes in forest habitat structure through unsustainable logging, eutrophication of freshwater systems through aquatic pollution. The effects of disease associated with human activities may also be considered here (e.g., disease transmitted to wildlife from domestic livestock). As with other pressures, the significance of disease should be considered in the context of its potential to contribute to significant alterations in ecosystem *structure, function* or *composition*.

Indicators should ideally focus on the impacts rather than the pressure (for example, focusing on reductions in fish biomass rather than numbers of fishing vessels) where data are available. For each *site*, a set of human pressure indicators can be developed to help evaluate the *ecological integrity* of the site. In some cases, species that are sensitive to specific pressures can provide relevant indicators (e.g., all large hunted and harvested species; invertebrates and lichens that indicate water and air quality; species that are sensitive to climate change; Karr, 1981; Redford, 1992; Thiollay, 1992).

Characteristics of effective indicators

Indicators must be measurable. The following factors should be considered when selecting specific *indicators* for assessing a particular *site*:

- a) Ecosystem relevance: Consider whether loss or degradation of the *ecological integrity attribute* or *indicator* would lead to significant alteration in ecosystem *structure, function* or *composition*.
- b) Comprehensiveness: Wherever possible, *indicators* should be selected for all the *ecological integrity attributes* identified above for the main ecosystems at the *site* to capture elements of ecosystem *structure, function* and *composition*.
- c) Sensitivity to meaningful ecosystem change: *Indicators* should be performance tested to demonstrate that their relationship to ecosystem change is predictable.
- d) Availability and quality of data for the *site* and *high-integrity reference states*. Reliable quantitative data may not be available, especially for remote *sites*; expert judgement, ideally based on multiple lines of evidence, will likely play an important role in *site* evaluation.

5.4.1 Evaluating existing/potential sites to assess their ecological integrity under Criterion C

Site evaluation should be conducted prior to proposing any *site* as a *KBA* to confirm the presence of fully functional ecosystem types and their components. *KBA Proposers* should verify information gained from remotely sensed datasets, as well as information that cannot be inferred from remotely sensed data, such as overexploitation, presence of invasive transformer species, and water quality.

Evidence may come from workshops or interviews with *biodiversity* knowledge-holders, including ecologists, ecosystem experts, holders of *Indigenous and Local Knowledge (ILK)*, see below and Section 8.1) and *site* managers, recently collected data or new field surveys. *Site* evaluation should include workshops and/ or interviews with relevant knowledge-holders and experts to validate the evidence for the outstanding ecological integrity of the site and supporting data, particularly those that are out-of-date. The *KBA Proposer* should provide a brief explanation of why any data older than 12 years are still considered valid (for example, no more recent data are available and no major ecological or human management changes have occurred in the area in the intervening period). Interviews and *site* evaluation may be conducted by local experts other than the *KBA Proposer*, but must be documented (see Section 9.1).

What is the role of Indigenous and Local Knowledge (ILK) in site evaluation?

Many **sites** that may qualify as **KBAs** under Criterion C will coincide with Indigenous territories and local communities, and **ILK** will play an important role in evaluating all aspects of **ecological integrity** including high-integrity reference states as well as **site** delineation in this context. (For example, **ILK** can be applied in assessing species *composition*, abundance and distribution, and in discovering the extent of natural resource use and exploitation over time.) **Free, Prior and Informed Consent (FPIC)** is required prior to the publication or display of previously unpublished **ILK** (see Section 8.1 for further guidelines). Any **KBA** proposal based on data derived from previously unpublished **ILK** should be flagged for review during the submission process (see the **KBA Proposal Process guidance**).

What happens if a site does not qualify as an outstanding example of ecological integrity at the global scale?

The process of assessing a **site** under Criterion C involves determining where a **site** falls on the spectrum from outstanding **ecological integrity** to degraded.

If a site does not represent an example of outstanding **ecological integrity** at the global scale based on a weight-of-evidence approach applied to the full set of **ecological integrity indicators**, but is characterised as having relatively high **ecological integrity** at the regional scale, it may qualify as a regional **KBA** following guidelines for regional application of the **KBA** criteria (to be developed in due course).

5.4.2 Selecting sites in ecoregions with more than two sites with potential to trigger Criterion C

Sites qualifying under Criterion C represent examples of outstanding **ecological integrity** at the **global** scale. The **KBA Standard** states that the maximum number of **sites** that can qualify under Criterion C is two per **ecoregion** (IUCN, 2016, p. 21).

When proposing **sites** that include parts of more than one **ecoregion** under Criterion C, **KBA Proposers** should specify the primary **ecoregion(s)** at the **site** so that the **KBA** does not count towards the two sites per ecoregion threshold for ecoregions with limited coverage by the **site**.

How are sites selected when there are more than two potential sites that could trigger Criterion C in an ecoregion?

For **ecoregions** that are the focal **ecoregion** for more than two potential **sites** that could trigger Criterion C, **site** selection will likely be an iterative process, possibly involving

considerations of ecosystem representation and/ or a comparative analysis of *ecological integrity attributes* and *indicators*.

5.4.3 Refining ecological boundaries, if necessary, to yield practical KBA boundaries

KBA delineation is not complete until ecological boundaries have been evaluated and refined, if necessary, to yield a **manageable site** or **sites** (see Section 7.3 for further guidelines). See Section 8 for guidelines on consultation and involvement of customary rights-holders and other stakeholders.

5.4.4 Compiling required and recommended documentation under Criterion C

See the **KBA Proposal Process guidance** for required and recommended documentation for **sites** proposed as qualifying Criterion C.

6. Identifying Key Biodiversity Areas based on quantitative analysis of irreplaceability (Criterion E)

6.1 Irreplaceability and complementarity

Criterion E is a species-based criterion, like Criteria A1, B1-3, and D1-3. Criterion E aims to identify sites that have very high irreplaceability for the global persistence of biodiversity because they are very likely needed as part of a global network of complementary sites designed to achieve predefined representation targets for all species.

Sites identified as KBAs under Criterion E should have very high irreplaceability (i.e. at least 0.9 on a scale of 0 to 1).

The KBA Standard defines irreplaceability as follows: “Either (a) the likelihood that an area will be required as part of a system that achieves a set of targets (Ferrier et al., 2000) or (b) the extent to which the options for achieving a set of targets are reduced if the area is unavailable for conservation (Pressey et al., 1994). Irreplaceability is heavily influenced by geographically restricted biodiversity, but it is a property of an area within a network rather than of an element of biodiversity and is related to the concept of complementarity.”

The KBA Standard defines complementarity as follows: “A measure of the extent to which an area contains elements of biodiversity not represented, or that are underrepresented, in an existing set of areas; alternatively, the number of unrepresented or underrepresented biodiversity elements that a new area adds to a network (Margules & Pressey, 2000).”

Irreplaceability is a function of the conservation features considered (e.g., species), their established representation targets (i.e. the desired amount of a species' global population size or distribution incorporated in a network of sites), and the size of spatial units (e.g., grid cells).

Sites are irreplaceable if there is insufficient area (or combination of sites) that can replace them while maintaining species' representation, and have high irreplaceability if there are very few options (i.e. limited area or combinations of sites) for doing so.

Sites with very high **irreplaceability** are thus important for the persistence of biodiversity, especially species that are geographically concentrated or have **population sizes** not much greater than the representation **target**, such that there is limited spatial flexibility to meet the **target**.

Criterion E may also identify some **sites** that have high **irreplaceability** because of their importance for a combination of species or set of biodiversity elements (IUCN, 2016, p. 25), including some species with broader distributions. These **sites** are highly likely to be required as part of an efficient network for achieving the set of representation **targets**. Typically, there are many possible combinations of **complementary sites** that can achieve a given set of species' representation **targets**, with different spatial configurations. Some of these combinations are more efficient than others, achieving representation **targets** in a smaller total area, for example.

Sites that qualify under Criterion E are **KBA**s in their own right, but quantitative analysis of **irreplaceability** may also serve as a useful scoping tool for identifying sites that might meet other criteria (especially A1 and B1-3). **KBA NCGs** and **KBA Proposers** are encouraged to take advantage of this to assess **sites** identified as having very high **irreplaceability** under Criterion E against other criteria (IUCN, 2016, p. 5). Assessing **sites** against multiple criteria will strengthen the robustness of **KBA** identification to changes in the status of **trigger** species and available data.

6.2 Preparing datasets for Criterion E analysis

A **site** qualifies as a **KBA** under Criterion E because it has a level of **irreplaceability** of ≥ 0.90 (on a 0–1 scale), measured by quantitative spatial analysis, and is characterised by the regular presence of species with ≥ 10 **reproductive units** known to occur (or ≥ 5 units for EN or CR species).

Figure 6.1 presents a possible workflow for applying Criterion E. Analysis will generally be conducted in two distinct stages, starting with preparation of datasets and followed by implementation and review.

The **KBA Standard** recommends using equal-area (or approximately equal-area) spatial units in an initial scoping analysis, and then repeating the analysis following delineation, using delineated **sites** to determine the final **irreplaceability** scores of **sites** that will be proposed as **KBA**s. However, **KBA NCGs** and others involved in Criterion E analysis to date recommend a workflow that starts with preparation of datasets based on spatial units that align with ecological and management boundaries and where there is high confidence that species are present.

KBA NCGs and other KBA Proposers may still choose to conduct preliminary scoping analysis to investigate the sensitivity of **irreplaceability** to potentially significant choices, such as the size of spatial units, and to identify spatial units where it would be useful to confirm species' presence prior to conducting the final analysis.

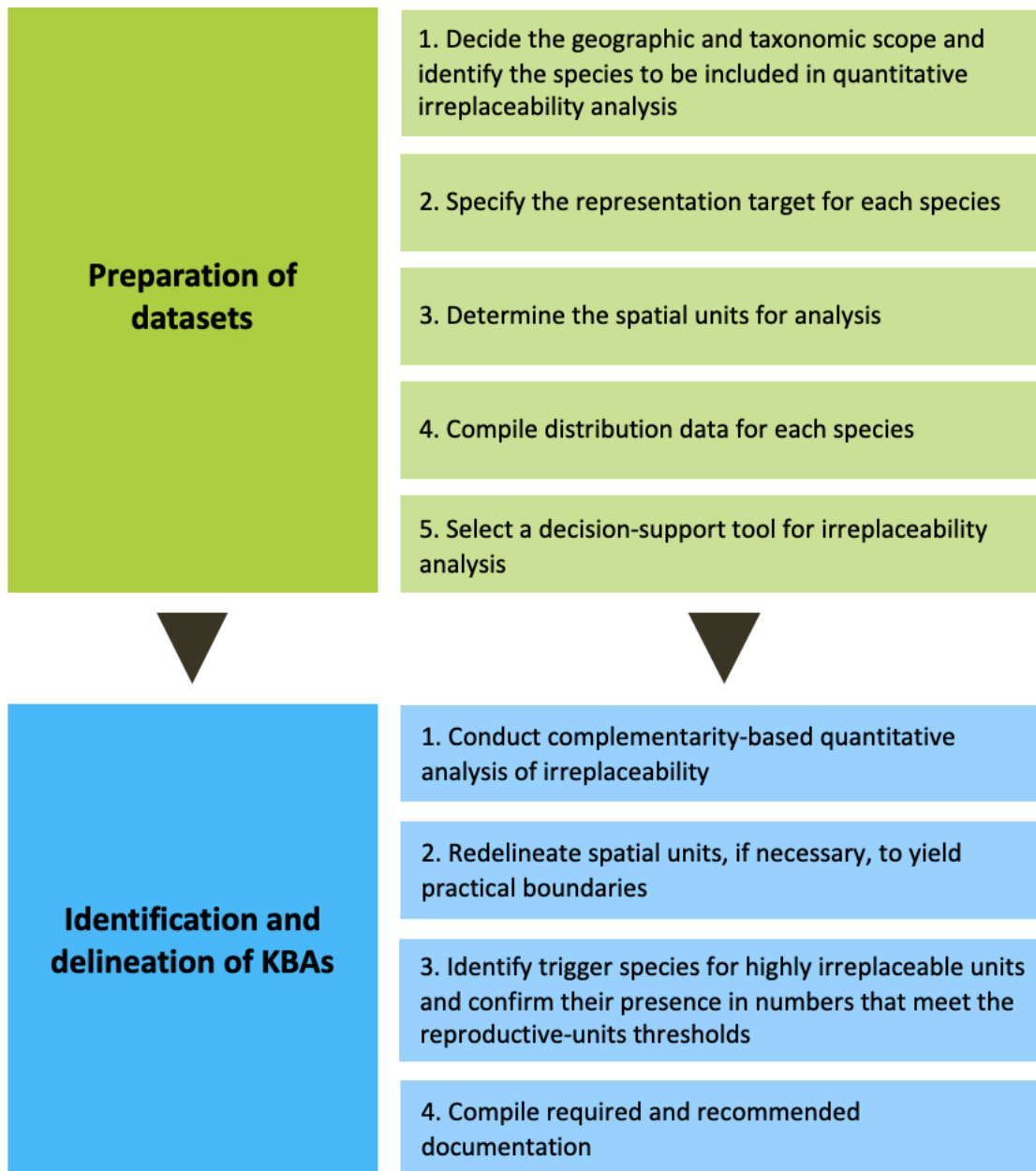


Figure 6.1 Overview of possible workflow for applying Criterion E. *Source: Compiled by the KBA SAC.*

6.2.1 Decide the geographic and taxonomic scope for analysis.

What is the appropriate geographic scope for applying Criterion E?

The **KBA Standard** states that **irreplaceability** analysis needs to take into account the entire **range** of species, and so must either (a) be conducted at a **global** scale, or (b) focus only on species **endemic** to the region analysed, or (c) focus on a study region after setting the representation **targets** to reflect the fraction of the **global population size** of each species that is included in the study region (IUCN, 2016, p. 25).

In all three cases (a – c), the definition of targets needs to take into account the **global population size** (or distribution) of the species, rather than just the **population size** (or distribution) within the subglobal region analysed. This is straight-forward for analyses (a) at the **global** scale or (b) for species **endemic** to the study region in subglobal analyses.

For non-**endemic** species (c), The **KBA Standard** states that representation **targets** should be adjusted to reflect the fraction of the **global population size** in the study region (see Section 6.2.2). Following testing, we recommend that only species with $\geq 10\%$ of their population or **range** within the study region are included in subglobal analysis for Criterion E. Previous concerns that species with only a small proportion of their **global population size** within the study region might lead to **sites** being identified as highly **irreplaceable** because of limited spatial flexibility were not supported once representation **targets** were adjusted to reflect the fraction of the **global population size** in the study region (see Section 6.2.2).

As with all **KBAs**, **KBA** identification under Criterion E should be locally driven, ideally coordinated by a **KBA NCG**. Collaboration between **KBA NCGs** and **KBA Proposers** in neighbouring countries within the same biogeographic region is encouraged, especially if the combined study region would reduce the number of edge-of-range species (i.e. species with a small percentage of their population or **range** within the study region). **KBA RFPs** should coordinate with **KBA NCGs** and other **KBA Proposers** to ensure that **sites** are not proposed as **KBAs** based on Criterion E analyses that overlap both spatially and taxonomically. Global analyses may serve as valuable scoping and evaluation exercises and international organisations may play a valuable supporting role, but are not an alternative to **site** identification processes led by local or national constituencies.

What is the appropriate taxonomic scope for applying Criterion E?

Criterion E analysis may be conducted separately for terrestrial, freshwater, and marine systems. If so, species that occur in multiple systems may be identified as trigger species in more than one system (for example, seabird breeding colonies may contribute to **irreplaceability** in terrestrial analyses, while seabird foraging areas may contribute to **irreplaceability** in marine systems).

For each system, the recommendation for applying Criterion E is to conduct the most comprehensive analysis possible given the available data (i.e. including all species with suitable data).

Once a Criterion E analysis is complete and **KBAs** have been confirmed, re-analysis will not be required when new data become available until the end of the 8-12 year reassessment period. However, if additional data do become available, **KBA NCGs** or **KBA Proposers** may choose to revisit Criterion E analysis, combining the old and new datasets, at any time. If a **site** previously identified as a **KBA** under Criterion E no longer meets the 0.9 **irreplaceability threshold** and does not meet any other **KBA** criteria, it will no longer be considered a **KBA** (see Section 10 for more detailed guidance on reassessment).

Which species can be included in quantitative irreplaceability analysis under Criterion E?

Section 2.2 provides general guidelines on identifying species that can trigger **KBAs** (including Criterion E **KBAs**). For species included in the **IUCN Red List**, for example, the taxonomy needs to be consistent with the **IUCN Red List** (Section 2.2.1), and species only known from their type **locality** should not be included without first checking whether the species might occur more widely. This information should be available in the **IUCN Red List** account. If it is not, **KBA Proposers** should check with **IUCN Red List** assessors.

Can migratory species be included in quantitative irreplaceability analysis under Criterion E?

Migratory species may be included; see Section 6.2.2 for guidelines on setting representation **targets** for migratory species.

6.2.2 Specify the representation target for each species.

Under Criterion E, representation **targets** are set for each species individually, as defined in the **KBA Standard** (IUCN, 2016, pp. 24-25). There are two types of **target**,

applicable to species with different types of available data. For each species, one type of target should be selected, based on the data available:

- Population-based **targets** (i.e. Ea) apply to species for which it is possible to know, estimate or infer the number of **mature individuals** per spatial unit. Representation **targets** are then set in terms of number of **mature individuals**.
- Area-based **targets** (i.e. Eb) apply to species for which only distribution data are available (e.g., **range** or **AOO**). Representation **targets** are then set in terms of area, with the implicit assumption that population density is constant across the species' distribution.

Note that Ea and Eb represent different types of **target**, not separate subcriteria. A single analysis may include some species with population-based **targets** and others with area-based **targets**. The two types of **target** parallel each other, describing a consistent level of representation for any given species (i.e. a minimum of 1,000 **mature individuals** AND a minimum area of 1,000 km² within the species' **range** or 20 km² within the species' **AOO**). In practice, however, the two types of **target** may lead to different results because of spatial variation in densities. (See Section 6.2.4 for discussion of which type of **target** and data type to use.)

The representation **targets** are reproduced here, with minor edits for clarification (please also see the flowchart shown below in Figure 6.2).

- (a) The **site** network should encompass at least X **mature individuals** of each species, where X is the largest value possible among:
 - i. the total number of individuals currently existing in the wild, if either: the **global population size** is fewer than 1,000 **mature individuals**; or the species' **range** is smaller than 1,000 km²; or the **area of occupancy** is smaller than 20 km²;
 - ii. the **population size** necessary to ensure the **global persistence** of the species with a probability of $\geq 90\%$ in 100 years, as measured by quantitative population viability analysis;
 - iii. 1,000 **mature individuals**;
 - iv. the number of **mature individuals** expected to occupy, at average densities, 1,000 km² within the species' **range** or 20 km² within the species' **area of occupancy** (as appropriate).
- (b) The **site** network should encompass at least an area of Y km² for each species, where Y is the largest value possible among:

- i. the total area where the species occurs, if either: the **global population size** is fewer than 1,000 **mature individuals**; or the species' **range** is smaller than 1,000 km²; or the **area of occupancy** is smaller than 20 km²;
- ii. the area necessary to ensure the **global persistence** of the species with a probability of $\geq 90\%$ in 100 years, as measured by quantitative viability analysis, up to a minimum of 10% of the total species distribution (i.e. **range** or **area of occupancy**, as appropriate);
- iii. 1,000 km² within the **range** or 20 km² within the **area of occupancy** (as appropriate);
- iv. the area corresponding to the **range** or the **area of occupancy** (as appropriate) necessary to include 1,000 **mature individuals**.

If the **global population size** is less than or equal to 1,000 **mature individuals**, the species' **global range** is less than or equal to 1,000 km² or the **AOO** less than or equal to 20 km², the representation **target** should be set to equal the entire **population size**, **range** or **AOO**.

The representation **targets** should be greater than 1,000 **mature individuals** (or 1,000 km² of **range** or 20km² of **AOO**) if quantitative viability analysis indicates that that is necessary to ensure $\geq 90\%$ probability of **global persistence** in 100 years.

Under population-based **targets** (i.e. Ea), X is the largest *possible* value among Eai-iv. (Target Eaii only needs to be considered if a suitable quantitative viability analysis is available.) Similarly, under area-based **targets** (i.e. Eb), Y is the largest *possible* value among Ebi-iv. (Target Ebii only needs to be considered if a suitable quantitative viability analysis is available.)

When setting targets based on **range**, species that occur at average densities of ≥ 1 mature individual per km² will have a representation **target** of 1,000 km², whereas species with lower average densities will have a representation **target** greater than 1,000 km² in order to encompass 1,000 **mature individuals**. (For example, for a species with average densities of 0.1 **mature individual** per km² of **range**, this would translate to 10,000 km².)

When setting targets based on **AOO**, species that occur at average densities of ≥ 50 **mature individuals** per km² will have a representation **target** of 20 km², whereas species with lower average densities will have a representation **target** greater than 20 km² in order to encompass 1,000 **mature individuals**. (For example, for a species with average densities of 5 **mature individuals** per km² of **AOO**, this would translate to 200 km².)

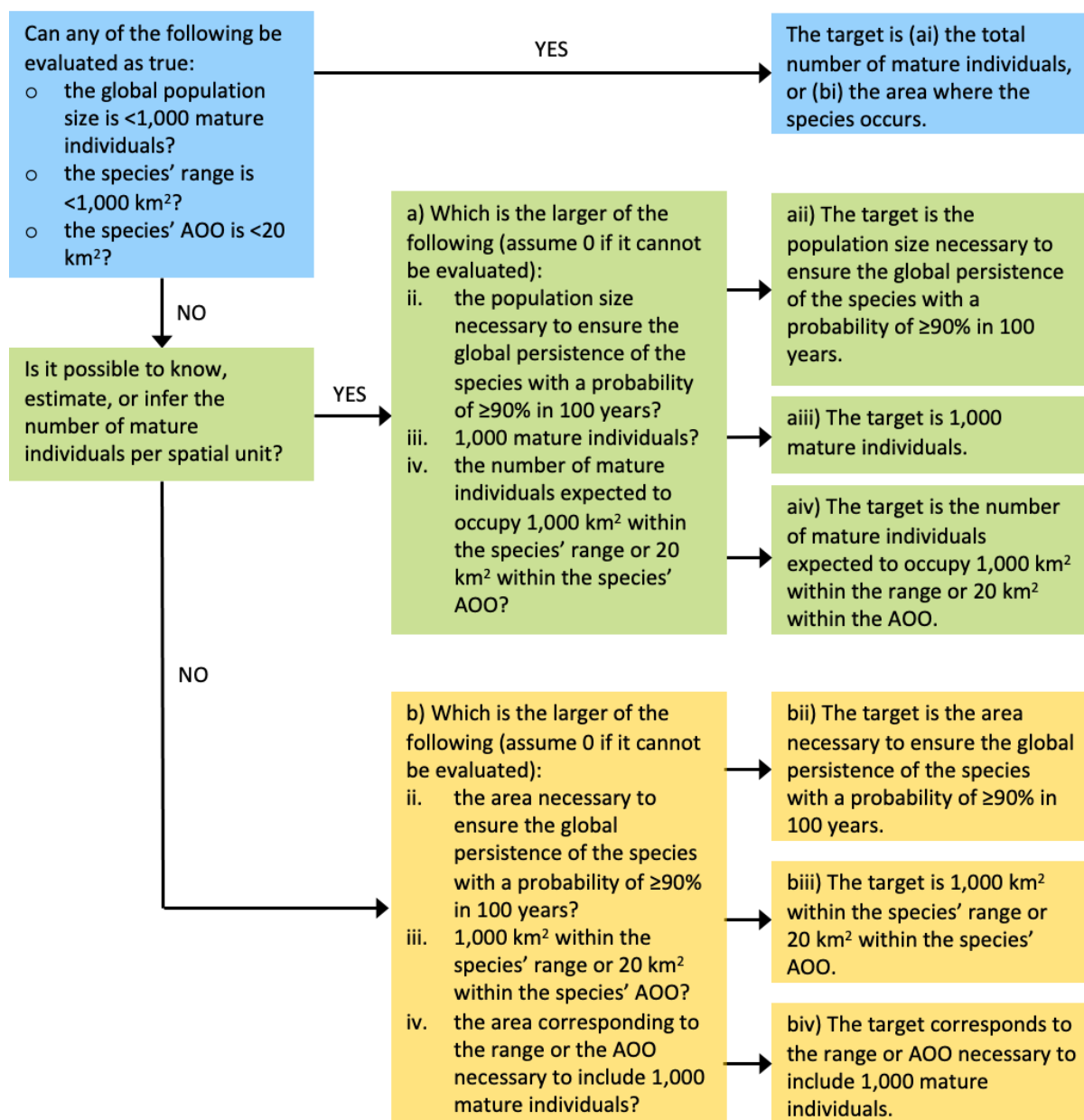


Figure 6.2 Selecting species representation targets for Criterion E. *Source: Compiled by the KBA SAC.*

How are representation targets set for non-endemic species?

For any species that is not **endemic** to the region analysed, the representation **target** must be adjusted to reflect the fraction of the **global population size** of the species in the study area (IUCN, 2016). For example, say the **global representation target** for a species is 1,000 **mature individuals** and 75% of the species' **global population size** occurs in the study region, then the representation **target** for the study region would be 750 **mature individuals** and analysis would be based on the species' distribution within the study region only.

Are there guidelines for quantitative viability analysis for targets Eaii and Ebii?

For **targets** Eaii and Ebii, quantitative viability analysis should be consistent with the general **IUCN Red List Guidelines** on applying Red List Criterion E (IUCN SPC, 2019, Section 9).

For **global** analysis or **endemic** species, quantitative viability analysis should be representative of the species' population dynamics at the global level, constructed from information sampled from at least 10% of the species' overall distribution. (This is the intention of the phrase "up to a minimum of 10% of the total species distribution..." in the **KBA Standard**, IUCN, 2016, pp. 24-25).

Targets for non-**endemic** species under Eaii or Ebii should be set to ensure the **persistence** of the species in the study region with a probability of $\geq 90\%$ in 100 years, and the quantitative viability analysis should be representative of the species' population dynamics within the study region, constructed from information sampled from at least 10% of the species' distribution within the study region.

How are representation targets set for coastal, riverine and other species with linear distributions?

In many cases, Criterion E analyses of freshwater systems will be based on subcatchments, as **range** maps for freshwater species are typically based on subcatchments (see **IUCN Red List Mapping Standards**).

However, in the special case of Criterion E analysis of riverine or coastal systems in which all species have linear distributions that do not exceed 200 km in width within the study region (e.g., an analysis of intertidal marine invertebrates), species representation **targets** may be rescaled to 50 km linear geographic span for **range**.¹⁶

How are representation targets set for migratory species?

For migratory species with well-defined spatially segregated **life-cycle processes**, such as breeding and non-breeding, representation **targets** should be set separately for each spatially segregated **life-cycle process** (e.g., 1,000 **mature individuals** or 1,000 km² in the breeding **range** and 1,000 **mature individuals** or 1,000 km² in the non-breeding **range**).

¹⁶ The scaling ratio is derived from the definition of restricted range, which converts the standard 10,000 km² threshold to 500 km for species with linear distributions.

6.2.3 Determine the spatial units for analysis.

The **KBA Standard** recommends that the study region is subdivided into spatial units that are equal-area or approximately equal area (IUCN, 2016, p. 25). Spatial units may be based on grid cells and/or irregular polygons representing subcatchments or existing **sites**. **KBA NCGs** with experience in applying Criterion E recommend using spatial units that align with ecological and management boundaries, while adhering to the recommendation that spatial units should be approximately equal area. Using actual or potential **sites** as spatial units avoids the need to repeat the analysis following delineation to determine the final irreplaceability scores as proposed in the **KBA Standard**. Large **sites** can be subdivided into smaller spatial units to maintain size consistency.

The **KBA Standard** recommends that spatial units should be approximately 100–1,000 km² (IUCN, 2016, p. 25). **HydroBASIN** subcatchments at levels 8-12 have an average size within this range. When deciding the size of spatial units, the following points should be taken into consideration:

- When identifying **KBAs** under Criterion E (or other criteria), the aim is to balance the risks of commission errors (species assumed to be represented but actually absent) and omission errors (species assumed to be absent but actually represented). When choosing the size of spatial units, the rate of commission errors can generally be reduced by avoiding spatial units that are so small that there is considerable uncertainty regarding whether the species is present in any given unit. In particular, if species distribution data are based on grid cells (e.g., atlas data), the size of spatial units used in **irreplaceability** analysis should not be smaller than the resolution of the input data (e.g., if the input data are for cells of 20 x 20 km² = 400 km², then spatial units should be 400 km² or larger).
- The size of spatial units affects the likelihood of identifying spatial units that meet the **irreplaceability** threshold. Smaller spatial units will lead to a smaller total area meeting Criterion E than with larger spatial units. Consequently, larger spatial units will generally lead to higher overall species representation than smaller spatial units.
- Nevertheless, spatial units should not be so large that they are unlikely to be **manageable** as a unit as these would need to be partitioned into smaller **manageable sites** later. The smaller **sites** could have much lower **irreplaceability** scores, invalidating the results. It is generally better to combine rather than split spatial units during final delineation.

6.2.4 Compile distribution data for each species.

In any analysis of **irreplaceability**, considerable effort will generally be required to compile comprehensive species distribution datasets across the entire study region. It is recommended that **KBA NCGs** and **KBA Proposers** invest in compiling high-quality comprehensive datasets, coding species as present only in spatial units where there is high confidence that the species is present. This will reduce the need to repeat the analysis later, if it is discovered that species are not actually present in relevant spatial units. However, it is recognised that, for many species, Criterion E analysis will need to be based on range or **ESH**, and analysis may need to be repeated if proposed trigger species are not found at proposed sites. These datasets can also inform identification of **sites** under other species-based **KBA** criteria.

Which type of target (Ea or Eb) is better for quantitative irreplaceability analysis under Criterion E?

KBA Proposers are encouraged to set targets in terms of the number of **mature individuals**, by estimating the number of **mature individuals** per spatial unit where possible. Data on the distribution of **mature individuals** provide the most direct measure of the contribution of a **site** to species persistence. Accounting for spatial variation in densities in this way will also maximise the consistency of **targets** across species.

Which types of data on the distribution of mature individuals can be used for population-based targets (Ea)?

Data on the number of **mature individuals** in each spatial unit may be actual counts or abundance estimates based on sample data or a spatial density model (see Appendix III), as long as it is possible to estimate numbers in absolute rather than relative terms (e.g., as number of **mature individuals** per km² rather than catch-per-unit-effort).

Which types of data can be used for area-based targets (Eb)?

In the context of quantitative analysis of **irreplaceability**, the choice of area-based assessment parameter from available options will affect the balance of risks between commission and omission errors. In particular, using **range** runs the risk of overestimating the true distribution, leading to commission errors in the analysis output (for example, some **sites** may be identified as having high **irreplaceability** despite the species not being present).

As noted above, it is recommended that species are only coded as present in spatial units where there is high confidence that the species is present to avoid the need to repeat the analysis after failing to confirm presence. This suggests there may be efficiency advantages from using atlas data (i.e. gridded presence/absence maps) where available. Atlas data may be used and treated similarly to [range](#) or [AOO](#) depending on the size of grid cells (see below).

The [KBA Standard](#) does not provide representation [targets](#) for [locality](#) or occurrence data. [Locality](#) or occurrence data must therefore be converted to [AOO](#) (see Appendix III.3) prior to quantitative [irreplaceability](#) analysis under Criterion Eb.

Range-type datasets:

[Range](#) maps for many species can be downloaded from the [IUCN Red List](#) (see Appendix III.1 for detailed guidelines on selecting relevant polygons etc.). If no [range](#) map exists for the species, [KBA Proposers](#) seeking to use [range](#) in Criterion E analysis should follow the guidance in the [IUCN Red List Mapping Standards](#) on developing distribution maps for estimating [range](#) (see also Appendix III.1).

[KBA Proposers](#) are encouraged to use [ESH](#) in place of [range](#) where available (using the same [targets](#) as for [range](#)). This will generally reduce the risks of commission error and be more efficient, especially if the [range](#) includes large unsuitable areas. Validated [ESH](#) maps will be provided through the [IUCN Red List](#) (spatial downloads page) when available. If [ESH](#) maps have not yet been developed, [KBA Proposers](#) seeking to use [ESH](#) should follow the guidance on estimating [ESH](#) in Appendix III.2.

[KBA Proposers](#) are also encouraged to use atlas data, if available, as this will generally reduce the risks of commission error and be more efficient than [range](#) or [ESH](#). Atlas data based on large grid cells (e.g., >2 x 2 km) should be treated as [range](#) data for the purposes of setting representation targets.

AOO-type datasets:

[KBA Proposers](#) are encouraged to use [AOO](#), where available and reliable. This will generally reduce the risks of commission error and be more efficient than [range](#) or [ESH](#) maps, especially for species that occur patchily at high densities within their [range](#) or [ESH](#). Validated [AOO](#) maps can be obtained from the [KBA Secretariat](#), if available. If [AOO](#) maps have not yet been developed, [KBA Proposers](#) seeking to use [AOO](#) should follow the guidance in the [IUCN Red List Mapping Standards](#) on estimating [AOO](#) (see also Appendix III.3).

KBA Proposers may also use atlas data, if available. Atlas data based on small grid cells (i.e. 2 x 2 km or smaller) that effectively distinguish between occupied and non-occupied parts of the **range** should be treated as **AOO** for the purposes of setting representation **targets**. If atlas data use grid cells smaller than 2 x 2 km, they should be scaled up to 2 x 2 km for consistency with the definition of **AOO**.

What about species that occur at very low densities?

Species that occur at very low densities and have a relatively small **global population size**, such that a very large area may be required to meet the representation **target**, can have a disproportionate effect on **irreplaceability** analysis. However, the species may not meet the relevant **reproductive-units threshold** in much of this area.

As a general recommendation, when using **global population size** to derive population-type **targets** (under Ea) or densities to derive area-based **targets** (under Eb), **KBA Proposers** should start by estimating the number of **mature individuals** per spatial unit. If this indicates that the number of **mature individuals** in some spatial units is much lower than the relevant **reproductive-units threshold** (i.e. 5 **reproductive units** for CR or EN species and 10 **reproductive units** for all other species), then the contributions of those spatial units to the species' representation **target** can be set to 0 as it is unlikely that the **reproductive-units threshold** will be met within the spatial unit.

6.2.5 Select a decision support tool.

Some **sites** can be identified as **irreplaceable** without the need for complex analysis. For example, if a **site** holds 500 **mature individuals** of a species with a **global population size** of 1,400 **mature individuals**, the site is **irreplaceable** – without it, it would not be possible to achieve the **target** of 1,000 **mature individuals**.

The recommended decision support tools for conducting **complementarity**-based quantitative analysis of **irreplaceability** under Criterion E are **Marxan** (Ball et al., 2009), Conservation Land-Use Zoning software (**CLUZ**; Smith 2019) or **prioritizr** using the replacement-cost function (Hanson et al., 2017). (See Appendix VI for further discussion of suitable decision support tools.)

Tools and metrics suitable for conducting **complementarity**-based quantitative analysis of **irreplaceability** under Criterion E are continually evolving. The set of recommended tools is expected to change over time. **KBA Proposers** initiating a new Criterion E analysis should follow current recommendations. The availability of new tools does not invalidate previous analyses, but **KBA Proposers** are encouraged to use

currently recommended tools when updating previous analyses or when the 8-12 year reassessment period is reached.

Criteria for evaluating future decision support tools will be developed in due course.

6.3 Applying Criterion E to identify KBAs based on quantitative analysis of irreplaceability

6.3.1 Conduct complementarity-based quantitative analysis of irreplaceability to identify spatial units that meet the irreplaceability threshold for Criterion E.

KBA assessment to identify **sites** under Criterion E should be implemented through **complementarity-based irreplaceability** analyses. A **site** qualifies as a **KBA** under Criterion E because it has a level of **irreplaceability** of ≥ 0.90 (on a 0–1 scale), measured by quantitative spatial analysis, and is characterised by the **regular** presence of species with ≥ 10 **reproductive units** known to occur (or ≥ 5 **reproductive units** for EN or CR species).

What types of cost layer can be included in quantitative irreplaceability analysis under Criterion E?

The purpose of **KBA** identification is to identify **sites** that **contribute significantly** to the **global persistence** of **biodiversity**, not to prioritise **sites** for conservation action. The only “cost” information included in quantitative **irreplaceability** analysis to identify **KBAs** under Criterion E is the area of each spatial unit. Additional cost considerations may be included, along with other factors, in subsequent conservation priority-setting (IUCN, 2016, p. 8; see also Smith et al., 2019, Table 1).

What consideration should be given to landscape/ seascape-level considerations when measuring irreplaceability?

Some decision support tools used in systematic conservation planning include optional features for integrating landscape/ seascape-level considerations (e.g., forcing selected **sites** to be as adjacent or connected as possible). Given that the purpose of **KBA** identification is to identify **sites** that **contribute significantly** to the **global persistence** of **biodiversity**, and not to design conservation landscapes or seascapes, these optional features should not be used. When using **Marxan** or **priorizr**, for example, the boundary-length modifier or penalty argument should be set to 0. Such landscape/ seascape-level considerations may be included, along with other factors, in subsequent conservation priority-setting exercises (see IUCN, 2016, p. 8).

6.3.2 Redelineate spatial units, if necessary, to yield practical KBA boundaries.

Identification of KBAs under Criterion E is not complete until spatial units identified as highly **irreplaceable** are delineated as **manageable sites** (see Section 7.3 for further guidelines). If the boundaries of spatial units align with ecological and management boundaries, as recommended above, then this should be straight-forward.

The boundaries of existing **sites** (e.g., existing **KBAs**, other **sites** of importance for **biodiversity**, protected or conserved areas) should be overlaid on spatial units with very high **irreplaceability** to generate a list of existing **sites** that might qualify as **KBAs** under Criterion E.

If a spatial unit with high **irreplaceability** falls wholly or largely within an existing **site**, then the **site's irreplaceability** can be inferred from the underlying spatial unit. If a spatial unit with **high irreplaceability** falls outside existing **sites**, then **site** boundaries may be derived from ecological and management boundaries that encompass the spatial unit (see Section 7.2).

If a spatial unit with high **irreplaceability** is too large to form a **manageable site** or only part of the spatial unit falls within a **site**, care must be taken to ensure that the proposed **site** boundaries encompass the area within the spatial unit that is driving high levels of **irreplaceability**. Otherwise, it is not possible to infer the **site's irreplaceability** from the spatial unit and the analysis may need to be repeated with smaller spatial units.

6.3.3 Identify and confirm the presence of proposed trigger species in numbers that meet relevant reproductive-units thresholds.

Identification of KBAs under Criterion E is not complete until the presence of proposed **trigger** species has been confirmed in numbers that meet or exceed the relevant **reproductive-units threshold** by reviewing recent field data or conducting new field surveys (see Section 9.2.3). The **reproductive-units threshold** for Criterion E is 5 **reproductive units** for CR and EN species, and 10 **reproductive units** for all other species.

The **trigger** species for each **site** are those whose presence at the **site** explains why **irreplaceability** exceeds the **threshold** for Criterion E. **Sites** may be identified as having very high **irreplaceability** because of one or more individual species with restricted distributions or a combination of species with broader distributions.

The simplest practical method for identifying **trigger** species for each **site** under Criterion E involves calculating the **irreplaceability** score using the “Ferrier method”

(Ferrier et al., 2000). An extension to conduct this analysis in `prioritizr` has been developed (`eval_ferrier_importance`).

6.3.4 Compile required and recommended documentation under Criterion E.

Reproducibility is especially important for Criterion E as the entire analysis may need to be repeated in the future to include additional species or data. **KBA Proposers** should provide a report documenting the methods in sufficient detail for another analyst to replicate the results, as would be required by a research journal. In particular, the geographic extent and spatial resolution, taxonomic scope and criteria used to identify species with adequate data, the decision support tool and parameters used should all be adequately documented. The target used for each species in the analysis (including those that did not qualify as trigger species) should be provided in an appendix. The input dataset (including planning units) should be archived, as required by many research journals, to provide a basis for updated analysis in the future.

7. Delineation procedures

Delineation is the process of defining the geographic boundaries of a **KBA** and is a required step in the **KBA** identification process. The aim is to derive **site** boundaries that are ecologically relevant and provide a basis for potential management activities. More specifically, the objective is to provide the best conditions for the long-term **persistence** of the **biodiversity elements** for which the **site** is important, dependent on their ecological requirements and the socio-cultural, economic and management context, within the constraint that the final delineated **site** meets the **threshold** for at least one **KBA** criterion.

Delineation is an iterative process that typically involves assembling spatial datasets (Section 7.1), mapping the distribution of **trigger biodiversity elements** and deriving initial boundaries based on ecological data (Section 7.2), refining ecological boundaries to yield practical **KBA** boundaries (Section 7.3), and documenting delineation (see the **KBA Proposal Process guidance**). In most cases, it will not be possible to complete this process in a single **KBA** identification and delineation workshop with a limited number of participants.

Stakeholder consultation and involvement is an essential element of the delineation process (see Section 8 for detailed guidelines). In particular, consultation with a range of knowledge-holders is recommended when assembling spatial datasets, mapping the distributions of **biodiversity elements**, delineating ecological boundaries, and refining ecological boundaries to yield practical **KBA** boundaries (Section 8.1). Consensus-building with proposers of existing **KBAs** (including **AZE sites**, **IBAs** and **KBAs** identified under previous initiatives) is required before significant modifications to the boundaries of existing **KBA** boundaries and to avoid overlapping **KBAs** (Section 8.2). Involvement of customary and legal rights-holders is recommended during the delineation process (Section 8.3). Once **KBA** identification and delineation are complete, additional consultation and involvement will generally be required before advancing any form of conservation or management action that might affect Indigenous peoples or other natural resource dependent communities (Section 8.4).

Is there a minimum or maximum size requirement for a KBA?

There is no absolute minimum or maximum size requirement for a **KBA**. The size of a **KBA** will depend on the ecological requirements of the **biodiversity elements** triggering the criteria, and consideration of **site manageability** (see Section 7.3). The

size distribution of existing protected or conserved areas may provide some guidance on the practical scale of management in each region. Previous initiatives (e.g., AZE sites or IBAs) can also be useful, if **manageability** was taken into account during delineation.

Sites identified under Criterion C are likely to be larger on average than **sites** identified under other **KBA** criteria, as are those in the open ocean compared with ones on land (see Section 5.2.2).

Why do KBAs need to be manageable as a unit and what does this mean?

The **KBA Standard** defines “**site**” as: “A geographical area on land and/or in water with defined ecological, physical, administrative or management boundaries that is actually or potentially **manageable** as a single unit (e.g., a protected area or other managed conservation unit)...” (IUCN, 2016, p. 7).

The **KBA Standard** defines “**manageability**” as: “The possibility of some type of effective management across the **site**. Being a **manageable site** implies that it is possible to implement actions locally to ensure the **persistence** of the **biodiversity elements** for which a **KBA** has been identified. This requires that **KBA** delineation consider relevant aspects of the socio-economic context of the **site** (e.g., land tenure, political boundaries) in addition to the ecological and physical aspects of the **site** (e.g., habitat, size, connectivity) ...” (IUCN, 2016, p. 13).

Another aspect of **manageability** is **site** accessibility. In some cases, the scale of **manageability** will be determined by how large an area can be monitored in practice using field-based monitoring techniques, given the configuration of roads or waterways or the range of typical survey vessels.

Taking **site manageability** into account during delineation will enhance the prospects for **biodiversity persistence** because conservation actions are more likely to be undertaken. However, the process of **KBA** identification and delineation does not include steps to advance management activity and does not imply that any specific form of conservation action, such as protected area designation, is required (IUCN, 2016, p. 8).

A **KBA** should be a **manageable** unit, but does not need to be a single *management* unit. Rather, there needs to be scope for effective management across the **site**. For example, a **site** that comprises several different ownership or management units (e.g., a protected area and adjacent private reserve) may be proposed as a single **KBA** if management can be coordinated across the **site**. Where a proposed **KBA** comprises

multiple management units, **KBA Proposers** should make the case that there is scope for some type of effective management across the **site** to support the **persistence of trigger biodiversity elements**. (See the **KBA Proposal Process guidance** for documentation of **manageability**).

Can the boundaries of KBAs overlap one another?

KBA boundaries should not overlap. This includes **global** versus regional **KBAs**. It also includes surface versus subterranean or deep sea **KBAs**, i.e. **KBA** boundaries should not overlap in 2-dimensional space. It is not possible to propose a subterranean cave and the terrestrial surface above it as two distinct **KBAs**; rather the two should form part of a single **KBA**. Similarly, it is not possible to propose an area of seabed and the surface waters or water column above it as two distinct **KBAs**; rather the two should form part of a single **KBA**, even though different management authorities may be involved.

KBAs with clear, non-overlapping boundaries are much easier to communicate to end-users than a set of overlapping **sites** that are important for different **biodiversity elements** and meet different **KBA** criteria.

In many areas, the distribution of **biodiversity elements** that have not previously been considered will overlap with existing **KBAs** (including **AZE sites**, **IBAs** and **KBAs** identified under previous initiatives). Many of these existing **KBAs** have national recognition, active conservation and monitoring initiatives and/or are linked to legislative and policy processes. **KBA Proposers** should work to harmonise proposed **KBA** boundaries with existing ones through consensus-building and agreement with the proposers of existing **KBAs** (see Section 8.2).

Can KBAs have dynamic boundaries?

KBAs should have fixed boundaries because **sites** displayed in the **WDKBA** must be stable, although it is anticipated that boundaries may change periodically as additional **biodiversity elements** are added or distribution patterns shift.

Where dynamic features are important, as for many marine species and freshwater/terrestrial species that depend on dynamic or ephemeral habitats, **KBAs** should be large enough to encompass those features, as long as there is scope for effective management at that scale.

KBAs that support **trigger biodiversity elements** seasonally (e.g., **KBAs** that support seasonal **aggregations** under Criterion D1) are also displayed with fixed boundaries in the **WDKBA**.

7.1 Assembling spatial datasets

What types of spatial datasets are useful for KBA delineation?

A range of different types of data may be useful for [KBA](#) delineation (see Table 7.1 for examples). Data layers should be of an appropriate spatial resolution to form the basis for delineating [manageable KBAs](#). See the [KBA website](#), [Plantlife IPA Database](#), [Ramsar Sites Information Service](#), and the [Protected Planet Database](#) for GIS data on existing [sites](#).

Table 7.1 Spatial datasets that may be useful for KBA delineation

Ecological datasets

Species data:

- locality data, including information on localities known to be important for specific life-cycle processes (e.g., breeding or moulting) or as ecological refugia (e.g., deep pools in rivers);
- tracking and movement data, including information on migratory bottlenecks;
- validated habitat maps (see Appendix III).

Ecosystem data:

- topographic data (e.g., elevation, bathymetry, slope, subcatchments, ridges, rivers, seamounts, outer reef passages);
- boundaries of land cover and benthic habitat classes;
- ecosystem type boundaries;
- ecoregion and bioregion boundaries.

Existing sites of biodiversity importance:

- boundaries of any existing KBAs (e.g., AZE sites, IBAs and KBAs identified under previous criteria);
- boundaries of other sites of biodiversity importance (e.g., IPAs, Important Marine Mammal Areas (IMMAs)) and designated biodiversity conservation sites (e.g., natural World Heritage sites, Ramsar sites, EBSAs).

Socio-economic datasets

Management data:

- customary Indigenous and community lands (both informal and formally recognised);
- other management units (e.g., private lands and concessions);
- other protected or conserved areas;
- administrative boundaries.

Human use data:

- human use areas (e.g., such as agricultural areas, logging concessions, fishing areas);
 - infrastructure, including cities, ports, roads, shipping lanes.
-

Source: Compiled by the KBA SAC.

7.2 Deriving initial KBA boundaries based on ecological data

The boundaries of a **KBA** should be based on ecological considerations, with adjustments for **manageability** as required.

7.2.1 Distribution maps for individual KBA trigger biodiversity elements

Distribution maps of **biodiversity elements** are a useful starting point for delineation where there are no existing **sites** in the area of interest, or **biodiversity elements** overlap with existing **sites** but do not align with their boundaries.

For well sampled **KBA trigger biodiversity elements**, it may be possible to derive distribution maps that represent the known local geographic distribution from observed **locality** data. In contrast, for elements with relatively few sampling **localities**, it may be necessary to infer the approximate geographic distribution using knowledge of habitat requirements combined with maps of remaining habitat or by using habitat models. Distribution maps should contain enough of each **trigger biodiversity element** to meet **KBA thresholds**.

For **trigger biodiversity elements** that do not occupy the entire **KBA**, it is recommended that **KBA Proposers** submit spatial data showing their distribution within the **KBA** with the **KBA** proposal, where possible. (Please see the **KBA Proposal Process guidance** for details.) These data will be used to support monitoring, possible targeted management actions, and possible redelineation in the future. With the exception of sensitive species (see Section 9.1.1), these will be visible in the **WDKBA**

when it is fully functional. Distribution maps are not requested for trigger **biodiversity elements** that occupy the entire KBA, but the **KBA Proposer** should make it clear that the **trigger biodiversity element** occurs throughout the **site**.

7.2.2 Deriving initial KBA boundaries based on ecological data

Where there is no existing **site**, initial **KBA** boundaries can be derived that encompass the distribution of overlapping **trigger biodiversity elements**. These initial **KBA** boundaries should generally be delineated so that the area contained within them is distinct from surrounding areas in terms of importance for the **trigger biodiversity elements** or habitat, while minimising the inclusion of land or water that is not relevant to the **trigger biodiversity elements**.

In addition to habitat, it is advisable to consider the spatial aspects of ecological boundaries, including size, edge:area ratio and connectivity with other natural areas. In particular, delineating boundaries that align with natural topographic or habitat features may enhance prospects for the **persistence** of **trigger biodiversity elements**.

If distribution maps of **KBA trigger biodiversity elements** are clipped during this process, it is important to check that the initial **KBA** boundaries still contain enough of each potential **trigger biodiversity element** to meet relevant **KBA** criteria and **thresholds**.

Does the area contained within a KBA need to support a minimum viable population of each trigger species?

No – populations of **trigger** species within **KBAs** may form part of a larger meta-population and so do not need to be self-sustaining. The area contained within ecological boundaries needs to meet the relevant **KBA thresholds**, including the **threshold** number of **reproductive units** (if applicable). It should be sufficient to sustain the **threshold population size** and number of **reproductive units** during the relevant seasons of the annual life-cycle (e.g., year-round for resident species and seasonally for migratory species), although it is recognised that this information will be unavailable for many species.

How can ecological boundaries be defined in wilderness areas?

KBA delineation may be challenging in areas of continuous habitat, such as wilderness areas (Upgren, et al. 2009). Data on species distributions are often lacking and data on remaining habitat may be of limited use because much of the habitat still remains. The

best approach may be to generate predictive maps of species distributions through habitat modelling, validated by additional surveys (see Appendix III).

In regions with multiple overlapping **biodiversity elements**, it may be helpful to start **by** locating areas where overlaps are concentrated. Areas of concentrated overlaps that differ from the surrounding areas (because they hold a number of biodiversity elements not found in other areas of concentration, for example) can provide a starting point for identifying independent **sites**; whereas areas of concentration that share many **biodiversity elements** may be best combined into a single **site**. This approach is a modified version of the procedure developed by Stattersfield et al., (1998) for application to landscape-scale areas that has also been used in a **site-planning** context (e.g., Lamoreux et al., 2015).

Topographic and environmental data such as elevation, bathymetry, ridgelines, seamounts, geological features and other identifiable elements of the land/seascape may also be used to delineate provisional ecological boundaries that can be refined using additional data to yield practical **KBA** boundaries (see Section 7.3.3).

7.3 Refining ecological boundaries to yield practical KBA boundaries

KBA delineation is not complete until ecological boundaries are evaluated for their **manageability** and refined, if necessary, to yield a **manageable site** or **sites**. Initial ecological boundaries based on the **trigger biodiversity element** should be retained for future reference, even if they do not become the final **KBA** delineated boundary.

Refining ecological boundaries to yield practical **KBA** boundaries will generally involve additional information (e.g., on land/resource tenure considerations) as well as stakeholder input.

Once practical **KBA** boundaries have been delineated, **KBA Proposers** should check that these contain enough of each **KBA trigger biodiversity element** to meet relevant **KBA thresholds**.

7.3.1 Refining boundaries with respect to existing KBAs

KBA delineation must take into account the boundaries of existing global or regional **KBAs** (including **AZE sites**, IBAs and **KBAs** identified under previous criteria). Many of these **sites** have national recognition, active conservation and monitoring initiatives and/or are linked to legislative and policy processes. This provides an opportunity for reassessment of existing **KBAs** for the original **trigger biodiversity elements**

(especially if these have not yet been assessed based on the [KBA Standard](#)) and a review of [manageability](#).

Some existing [KBAs](#) are very large, potentially encompassing multiple management units (e.g., logging concessions, forest reserves, and national parks). During the [reassessment](#) process, the same principles should be applied as for newly proposed [KBAs](#). If the existing [KBA](#) cannot now be considered actually or potentially [manageable](#) as a unit, then the [site](#) should be redelineated and possibly partitioned into multiple smaller [KBAs](#).

Any reassessment should involve consensus-building with proposers of the existing [KBA\(s\)](#) to the extent possible (Section 8.2). Consultation with owners and managers of the management units within the existing [KBA](#) is also recommended (Sections 8.1, 8.3).

The boundaries of an existing global or regional [KBA](#) may not be modified in such a way that the [site](#) no longer qualifies as a [KBA](#) for previous [trigger biodiversity element\(s\)](#) unless there is an agreement with the previous proposer that it makes sense to do this or the existing [KBA](#) extends to the landscape or seascape scale and does not meet the definition of a [site](#) under the [KBA Standard](#).

Delineation with respect to other [sites](#) of [biodiversity](#) importance and to protected or conserved areas is treated separately (see Section 7.3.2).

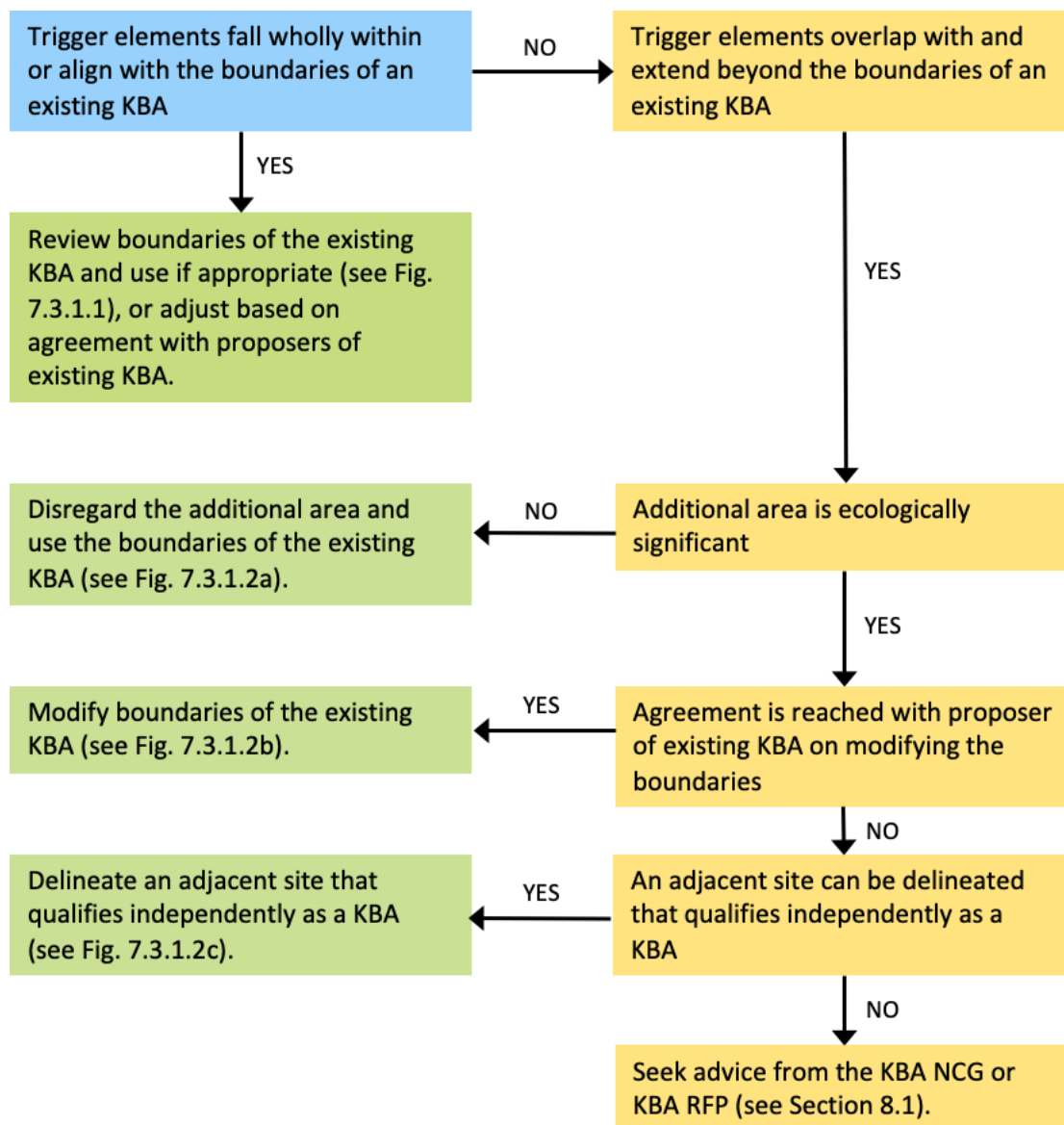


Figure 7.3.1. Refining boundaries with respect to existing KBAs (see text for further details). *Source: Compiled by the KBA SAC.*

What if the ecological boundaries for new KBA trigger biodiversity elements fall wholly within, or largely follow, the boundaries of an existing KBA?

Where the ecological boundaries for a new **KBA trigger biodiversity element** fall wholly within or largely follow the boundary of an existing **KBA** (Fig. 7.3.1.1), the boundary of the existing **KBA** should be used for delineation, unless reassessment of the **site** for the original **trigger biodiversity elements** or a review of **manageability** indicate otherwise. Data on the new **trigger biodiversity element(s)** should be added to the existing **KBA's** qualifying data (including distribution maps showing where the **trigger biodiversity element** occurs within the **KBA**, if it does not occupy the whole area). Involvement of the proposers and managers of the existing **KBA** is

recommended, even if there are no boundary modifications, as they may have additional relevant information on the spatial extent of **biodiversity elements** and they may be working to conserve the **site**.

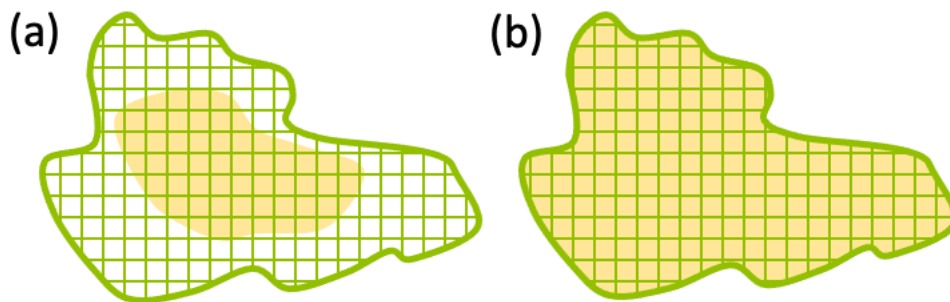


Figure 7.3.1.1 Ecological boundaries for biodiversity elements (a) fall wholly within the boundaries of an existing KBA; or (b) align with the boundaries of an existing KBA. The existing KBA is shown by green hatching; ecological boundaries are shown as a filled yellow polygon. *Source: Compiled by the KBA SAC.*

What if ecological boundaries for new KBA trigger biodiversity elements extend beyond the boundaries of an existing KBA?

Where **KBA trigger biodiversity elements** extend beyond the boundaries of an existing **KBA**, the options are as follows:

- The additional area may be disregarded if it is not important for the **persistence** of the **KBA trigger biodiversity element(s)** at the **site** and the **KBA trigger biodiversity element(s)** will still meet relevant **KBA thresholds** if the existing boundary is adopted (Fig. 7.3.1.2a). Data on the new **trigger biodiversity element(s)** should be added to the existing **KBA's** qualifying data.
- The existing **KBA** boundary may be modified (Fig. 7.3.1.2b) based on consensus-building and agreement with the proposers of the existing **KBA** (see Section 8.2), and within the confines of **manageability**. The data on the new **trigger biodiversity element(s)** should be added to the existing **KBA's** qualifying data. If the change in boundary affects existing **KBA trigger biodiversity elements** (for example, it increases the population of a potential **trigger** species or **extent** of an **ecosystem type** contained within the **KBA**), this information should be updated.
- If the proposers of the existing **KBA** are unwilling to modify its boundary (for example, because the **site** is linked to legislative or policy processes, or would no longer be a **manageable** unit) and the additional area is important for the **persistence** of the new **KBA trigger biodiversity element(s)**, a new adjacent **KBA** may be delineated as long as it qualifies independently as a **KBA** (Fig. 7.3.1.2c). If

proposers of the existing **KBA** are unwilling to modify its boundary and the additional area does not qualify independently, **KBA Proposers** should seek advice from the **KBA NCG** or **KBA RFP** (in that order).

The choice between these options will depend on the ecological significance of the areas outside the existing **KBA** for relevant **biodiversity elements**, the scale of **manageability**, and consensus-building with proposers of the existing **KBA** (see Section 8 on stakeholder consultation and involvement for further guidance). The case for modifying the existing **KBA** will generally be stronger if **trigger** species periodically move between the existing **KBA** and the additional area, such that coordinated management will likely increase the probability of **persistence**.



Figure 7.3.1.2 Ecological boundaries for biodiversity elements extend beyond the boundaries of an existing KBA: (a) additional area is ecologically insignificant; (b) boundary of existing KBA is modified to encompass the ecological boundaries of additional biodiversity elements; (c) a new KBA is proposed adjacent to the existing KBA. The existing KBA is shown by green hatching (and dashed green boundary); ecological boundaries are shown as a filled yellow polygon; proposed KBAs are shown as solid green boundaries. *Source: Compiled by the KBA SAC.*

7.3.2 Refining boundaries with respect to other sites of biodiversity importance, or protected or conserved areas

When a **biodiversity element** triggering one or more **KBA** criteria falls within a **site** of **biodiversity** importance not yet recognised as a **KBA** (such as a **site** identified using other criteria or processes, e.g., an IPA, IMMA, Ramsar site) or other protected or conserved area where active management is underway, it may be advisable to use the boundary of the other **site** of **biodiversity** importance or other protected or conserved area to delineate the **KBA**. Like **KBAs**, **sites** of **biodiversity** importance identified using other criteria or processes often have national or local recognition, active conservation and monitoring initiatives, and may be linked to legislative and policy processes. Most protected or conserved areas are recognised management units with a goal of

safeguarding the **biodiversity** contained within them. Where the boundaries of other existing **sites** of **biodiversity** importance or protected or conserved areas are suitable for the **biodiversity elements** triggering the **KBA** criteria and are **manageable** units, conservation efforts can be strengthened by using the same boundaries for **KBA** delineation. However, if their boundaries are not suitable for **KBA trigger biodiversity elements**, a **KBA** may be proposed that overlaps with other **sites** of **biodiversity** importance, or protected or conserved areas, with justification (see Fig. 7.3.2 for an overview).

Consultation with the managers of other **sites** of **biodiversity** importance or protected or conserved areas that overlap with proposed **KBAs** is recommended as they may have additional relevant information on the spatial extent of **biodiversity elements** and land/resource tenure and management in the area (see Section 8.1).

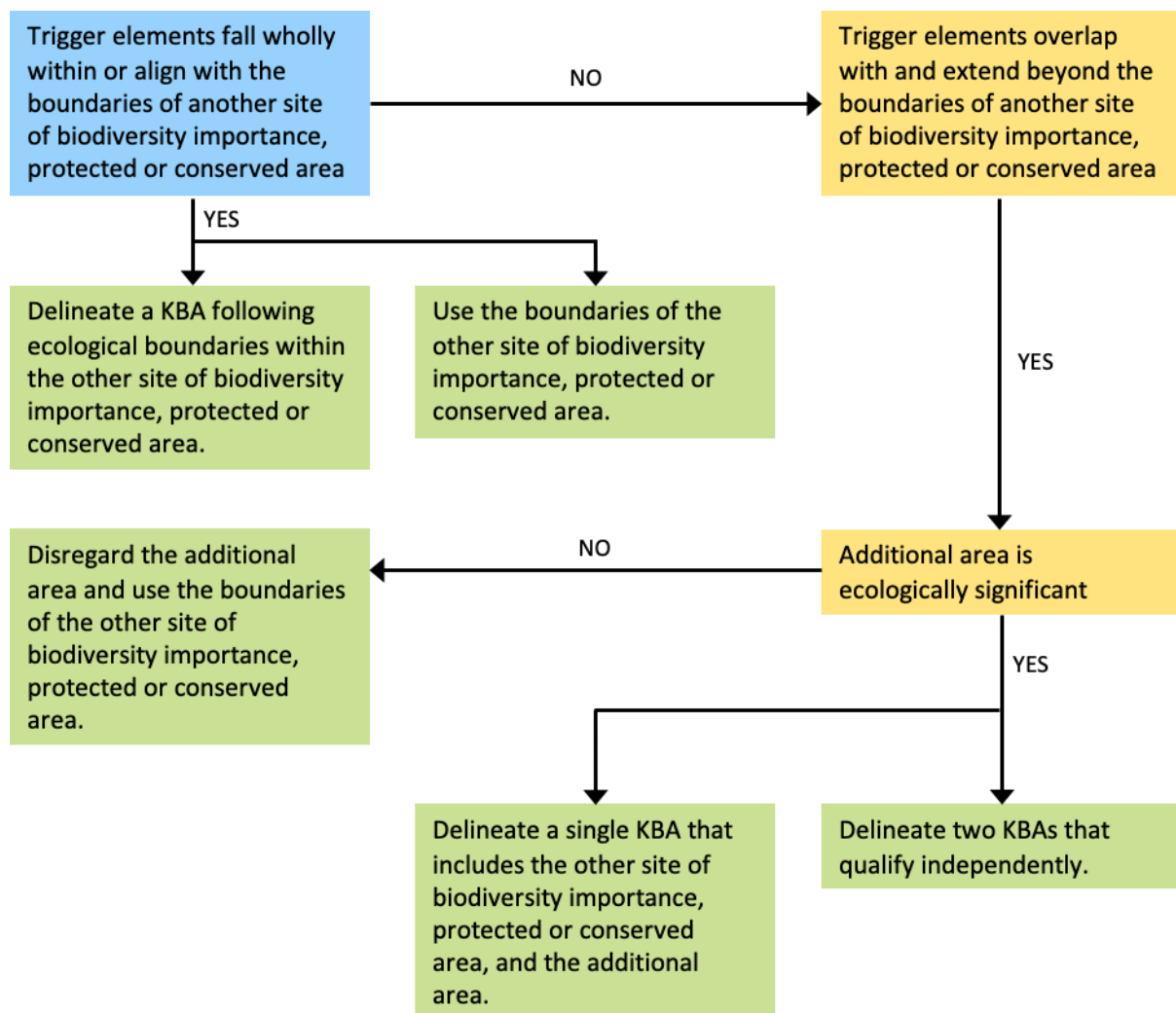


Figure 7.3.2. Refining boundaries with respect to other sites of biodiversity importance, protected or conserved areas. *Source: Compiled by the KBA SAC.*

7.3.3 Refining boundaries in the absence of existing KBAs, other sites of importance for biodiversity, or protected or conserved areas

When delineating sites that do not overlap existing KBAs, other sites of biodiversity importance, protected or conserved areas, other data on land/resource tenure and management may be used to derive practical KBA boundaries. These data may include administrative boundaries, Indigenous and community lands, private lands and concessions, community fishing areas, catchments used for integrated basin management and other long-term management units (see Table 7.1). Involvement of customary and legal rights-holders is recommended (see Section 8.3). See Figure 7.3.3 for an overview.

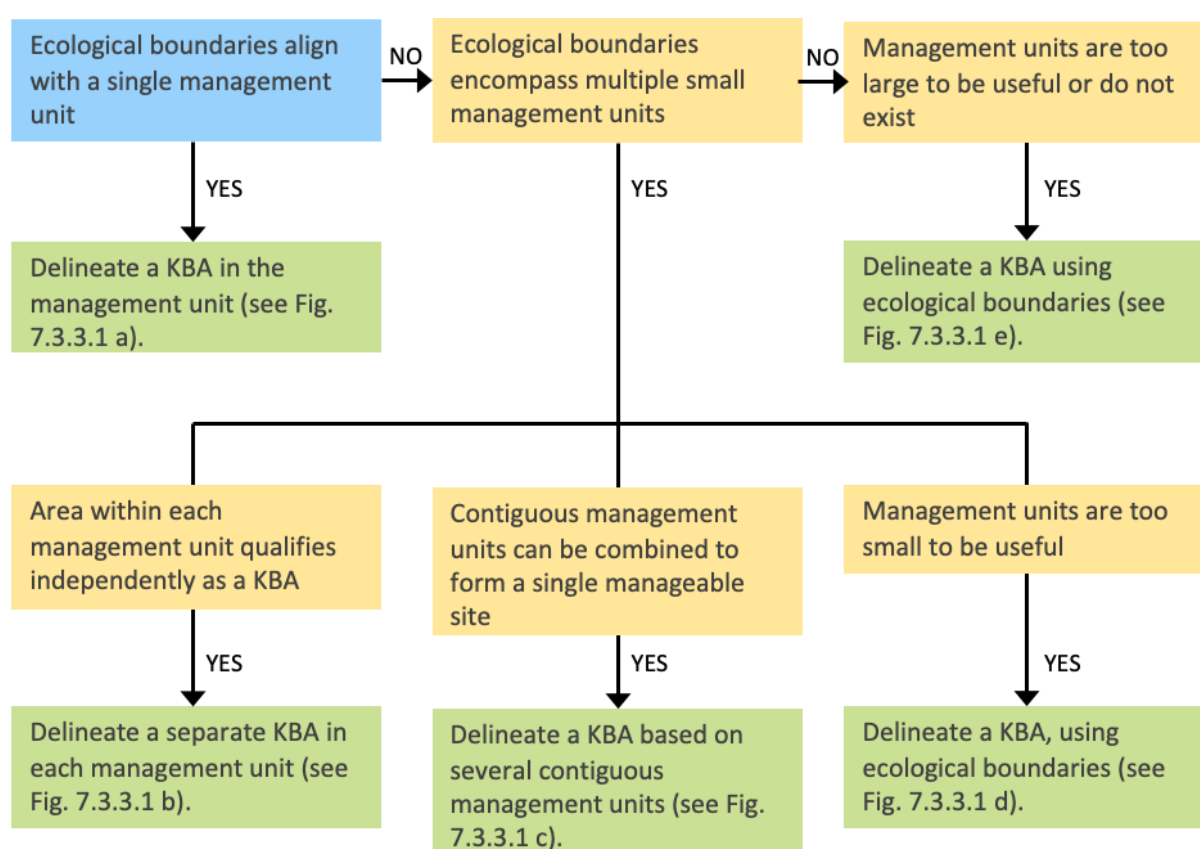


Figure 7.3.3. Refining boundaries in the absence of existing KBAs, other sites of importance for biodiversity, and protected or conserved areas. *Source: Compiled by the KBA SAC.*

What if management units are small and ecological boundaries encompass multiple distinct management units?

Ecological boundaries may encompass multiple management units or jurisdictions (e.g., landholdings, land management agencies, administrative areas). In this context, there are generally three options:

- If the area that lies within management units would qualify independently as a **KBA**, then identifying a separate **KBA** in each qualifying management unit will most likely align with the scale of practical management responsibilities and implementation (Fig. 7.3.3.1b).
- If management units would not qualify independently as **KBAs**, but there is scope for effective management across the **site**, then a **KBA** may be delineated based on multiple management units (Fig. 7.3.3.1c).
- If management units would not qualify independently as **KBAs** and are too small to provide a basis for coordinated management, then **KBA** delineation may be based on the ecological data used to derive initial **KBA** boundaries (Fig. 7.3.3.1d).

What if management units are too large to be useful or do not exist?

In some cases, management units may be too large to be useful (e.g., state/ provincial boundaries or EEZs) or may not exist (e.g., in wilderness areas or on the high seas, Fig. 7.3.3.1e). In such cases, the best approach is to base **KBA** delineation on the ecological data used to derive initial **KBA** boundaries (see Section 7.2).

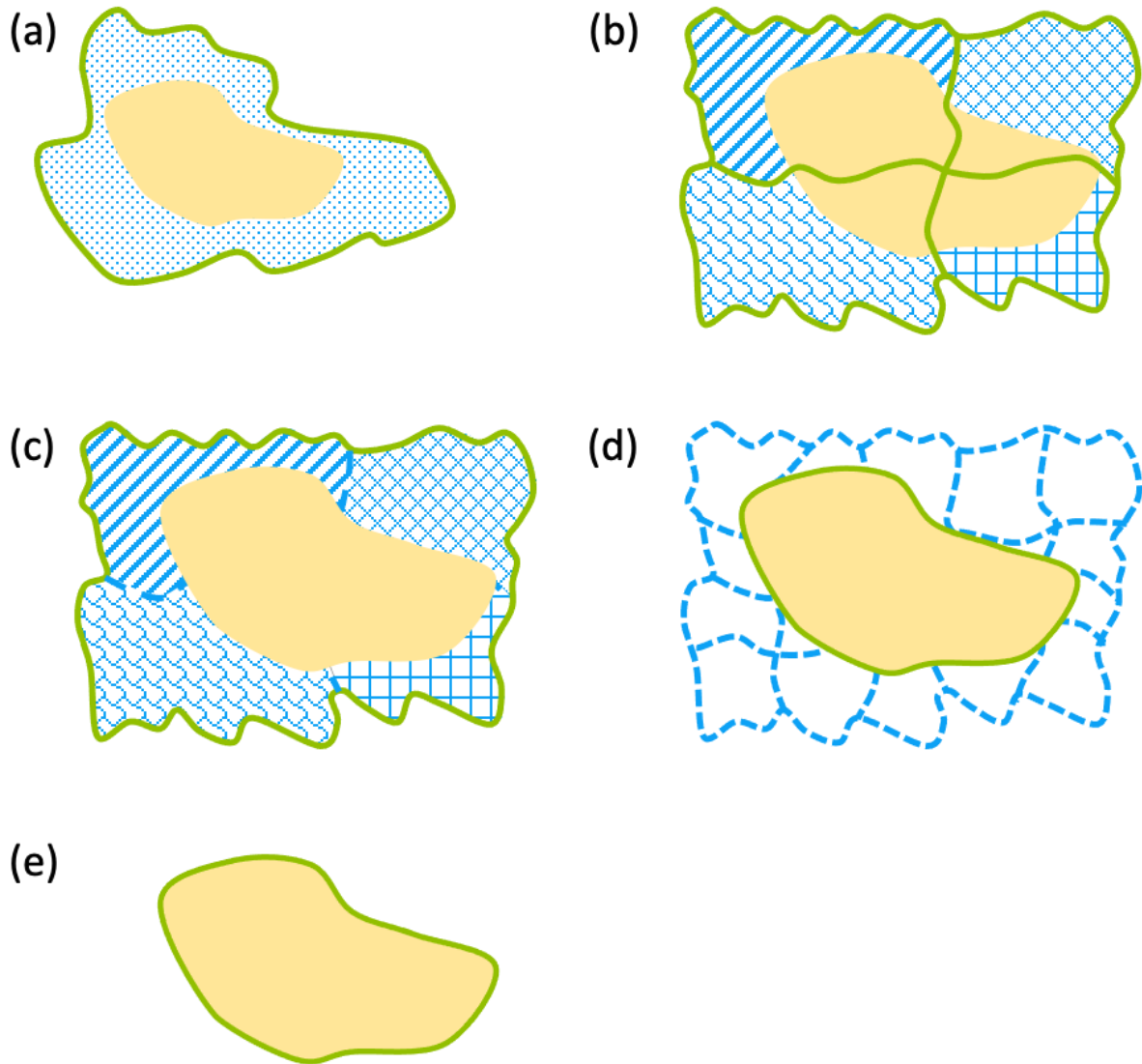


Figure 7.3.3.1 Refining boundaries in the absence of existing sites of importance for biodiversity, protected areas or other conservation areas: (a) a single management unit provides practical KBA boundaries; (b) contiguous management units qualify separately as KBAs and provide practical KBA boundaries; (c) contiguous management units are combined to form a single site with scope for effective management across the site; (d) management units do not qualify independently and are too small or heterogeneous to provide a basis for coordinated management, so ecological boundaries are used to delineate a proposed KBA as long as there is scope for effective management at this scale; (e) management boundaries are too large to provide practical KBA boundaries or do not exist, so ecological boundaries are used to delineate a proposed KBA as long as there is scope for effective management at this scale. Management units are shown as irregular shapes with dashed blue boundaries; ecological boundaries are shown as a filled yellow polygon; proposed KBAs are shown as green boundaries. *Source: Compiled by the KBA SAC.*

7.3.4 Additional questions

Can a KBA comprise several non-contiguous areas?

Some **KBA trigger biodiversity elements** have a patchy distribution such that ecological boundaries contain a number of distinct areas separated by unsuitable areas. The decision on whether to delineate one or several **KBAs** depends on several factors: in particular, whether separate areas would qualify as **KBAs** if delineated as separate **sites**; and **manageability**. The case for a single **site** will be stronger if non-contiguous areas fall within a single protected or conserved area (Fig. 7.3.4.1), or where a single **site** is more likely to lead to the effective conservation of the **KBA trigger biodiversity element(s)**.

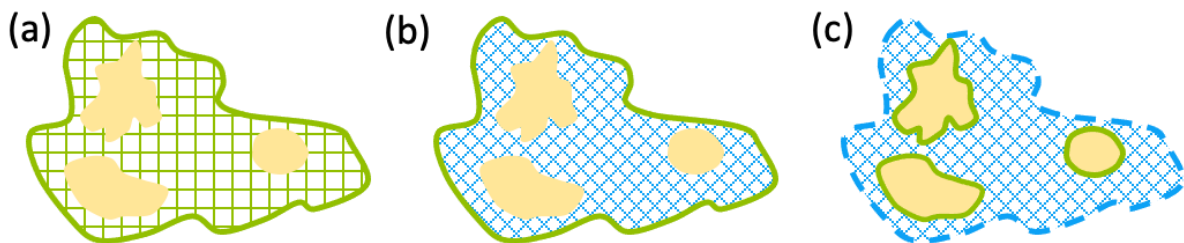


Figure 7.3.4.1 A KBA can comprise several non-contiguous areas: (a) biodiversity elements occur in patches within an existing KBA; (b, c) biodiversity elements occur in patches within an existing manageable unit such as a protected area — the solution shown in (b) is to delineate a single KBA following the protected area boundaries; whereas the alternative solution shown in (c) is to delineate one or more separate KBAs encompassing non-contiguous areas within a much larger manageable unit. An existing KBA is shown by green hatching; a protected area is shown by blue hatching; ecological boundaries are shown filled yellow polygons; proposed KBAs are shown as green boundaries. *Source: Compiled by the KBA SAC.*

Are there any special considerations for delineating sites under Criterion C?

See Section 5.2.2.

Are there any special considerations for delineating freshwater KBAs?

When delineating **KBA** boundaries for **sites** triggered by freshwater **biodiversity**, it may be appropriate to take subcatchments (e.g., **HydroBASINS** level 12) into account, if the amount of non-habitat area within the catchment is limited. As with all **KBAs**, there should be scope for effective management across the **site**.

The use of broader-scale catchment levels should generally be avoided, but may be useful for delineating KBAs proposed under Criterion C.

When delineating KBA boundaries for freshwater biodiversity, it may be appropriate to add a buffer to include riverine or lakeshore habitat, especially where the persistence of trigger species depends on the management of adjacent terrestrial habitat (for example, woody debris plays an important role in creating habitat for salmon spawning and rearing).

How can freshwater KBAs be aligned with existing terrestrial KBAs?

In many cases, freshwater biodiversity elements fall within or align with the boundaries of existing KBAs identified for terrestrial biodiversity. In some cases, however, the boundaries of existing terrestrial KBAs are inappropriate for delineating KBAs for freshwater biodiversity. For example, boundaries that follow rivers may exclude some or all of the area important for freshwater trigger biodiversity elements. Where freshwater biodiversity elements overlap with an existing KBA, KBA Proposers should follow the guidelines in Section 7.3.1. Where freshwater biodiversity elements overlap with other sites of biodiversity importance, or protected or conserved areas, KBA Proposers should follow the guidelines in Section 7.3.2.

What if ecological boundaries for single biodiversity elements extend to the landscape or seascape scale?

For some biodiversity elements, especially area-demanding species that occur at low densities across large areas of contiguous habitat, it may not be possible to delineate manageable sites that encompass a sufficient quantity to meet a KBA threshold. These biodiversity elements may depend primarily on conservation actions at the landscape or seascape scale rather than the site scale of KBAs (Boyd et al., 2008; IUCN, 2016, p. 4).

Whenever a large initial area (e.g., a landscape or seascape) is partitioned into smaller manageable units as the basis for identifying KBAs, it is important to estimate the population size of the smaller manageable units appropriately:

- Under Criteria A1, B1-3 and E, a site must regularly hold the threshold proportion of a species' global population size. If a species is distributed over a landscape or seascape that is partitioned into smaller manageable sites, the population size regularly held by each site should add up to the landscape/seascape population size.

- In contrast, Criterion D1 requires that a site *predictably* holds an **aggregation** meeting the **threshold** proportion of the **global population size** “over a season”. The phrase “over a season” is significant here. If a species forms a large **aggregation** that moves over the landscape or seascape over a season (e.g., a herd of wildebeest tracking fresh grass over a landscape), each of the smaller **manageable sites** may *predictably* hold the landscape/seascape population size over the season.

What if overlapping biodiversity elements extend to the landscape or seascape scale?

In some cases, distribution maps for different **biodiversity elements** yield multiple polygons that overlap in such a way that ecological boundaries surrounding them extend to the landscape or seascape scale (i.e. beyond the scale that is **manageable** as a unit, Fig. 7.3.4.2). In this case, delineation may involve parsing the different **biodiversity elements** into **sites** that are **manageable** in scale. The decision on whether to combine or separate management units into one or more **KBAs** will depend on whether ecological boundaries for some **biodiversity elements** align with management boundaries, whether management units qualify independently as **KBAs**, and the scope for effective management across management units.

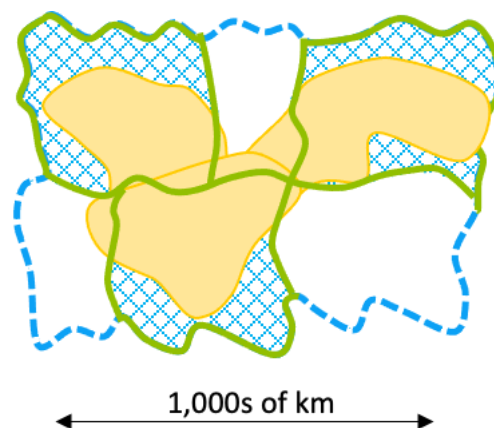


Figure 7.3.4.2 Ecological boundaries overlap and extend to the landscape or seascape scale. Management units are shown as irregular shapes with blue dashed boundaries; ecological boundaries are filled yellow polygons; proposed KBAs are shown as green boundaries. *Source: Compiled by the KBA SAC.*

What about transboundary areas?

Transboundary areas are an extreme example of **sites** where ecological boundaries extend over multiple management units (Fig. 7.3.3.1), and the principles are the same:

- If the area within each country would qualify independently as a **KBA**, then identifying separate **KBAs** in each country will most likely align with the practical division of management responsibilities and implementation.
- If the area within either country is ecologically significant (i.e. essential for the **persistence of trigger biodiversity elements**) but would not qualify independently as a **KBA**, and there is scope for effective management across the transboundary **site**, then a **KBA** may be delineated across the international boundary.
- If the area within either country is ecologically significant (i.e. essential for the **persistence of trigger biodiversity elements**) but would not qualify independently as a **KBA**, and realistically there is no scope for effective management across the transboundary **site**, the area may meet **thresholds** for regional significance, once those **thresholds** have been developed.

What if ecological boundaries encompass multiple overlapping jurisdictions?

In some cases, different resources or activities are managed by different agencies with spatially overlapping jurisdictions (Fig. 7.3.4.3). For example, fisheries may be managed by the fisheries management agency, shipping by the coastguard, or oil and gas development by an energy management agency. In this context, a **KBA** may be delineated based on the ecological data used to derive initial **KBA** boundaries (see Section 7.2). These initial **KBA** boundaries may be refined using topographic data (e.g., bathymetry, seamounts, and other bathymetric features) as appropriate, as long as there is scope for effective management at this scale.

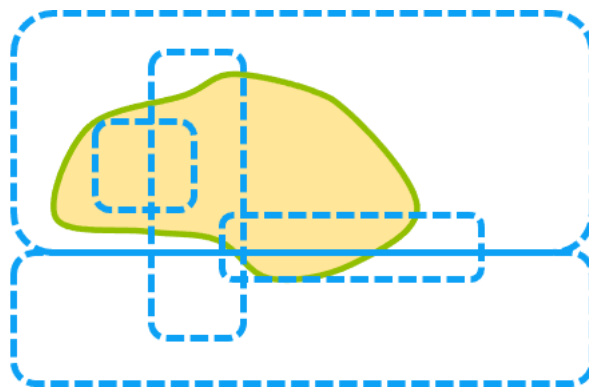


Figure 7.3.4.3. Ecological boundaries overlap multiple overlapping jurisdictions. Management jurisdictions are shown as regular shapes with blue dashed boundaries; ecological boundaries are shown as a filled yellow polygon; the proposed KBA is shown as a green boundary. *Source: Compiled by the KBA SAC.*

7.4 Documenting the delineation rationale and manageability

7.4.1 Documenting the delineation rationale

Documentation of the rationale for selecting the final KBA boundaries is required for each proposed KBA. KBA Proposers should provide text briefly describing the boundaries and why they were chosen, in addition to submitting a shapefile representing the KBA boundaries. For example, this text may simply explain that the KBA boundaries follow the boundaries of a community reserve or align with the edges of contiguous habitat for a particular trigger species. This information will be important if there is a need to redelineate the site in the future (e.g., to accommodate additional trigger species or facilitate management).

7.4.2 Documenting manageability

KBAs are sites that are actually or potentially manageable as a unit. KBA Proposers should provide text briefly explaining how manageability considerations were taken into account during site delineation. For example, this text may simply explain that the site is an existing national park, or combines a national park and state forest reserve that are managed under a coordinated management plan. This information is used in the review process and is required documentation.

8. Stakeholder consultation and involvement

The purpose of this section is to set out the stakeholder consultation and involvement that is required or recommended during the [KBA](#) identification and delineation process prior to [KBA](#) confirmation and publication on the [KBA website](#), consistent with the [KBA Standard](#).

The process of [KBA](#) identification and delineation by itself does not include steps to advance management activity. According to the [KBA Standard](#), “KBAs are sites of importance for the [global persistence](#) of [biodiversity](#). However, this does not imply that any specific conservation action, such as protected area designation, is required. Such management decisions should be based on [subsequent] conservation priority-setting exercises, which combine data on [biodiversity](#) importance with the available information on [site](#) vulnerability and the management actions needed to safeguard the [biodiversity](#) for which the [site](#) is important” (IUCN, 2016, p. 8). The [KBA Guidelines](#) on stakeholder consultation and involvement relate solely to the [KBA](#) identification and delineation process, and do not cover steps to advance management activity (but see Section 8.4 for some relevant policies).

For the purposes of [KBA](#) identification and delineation, we define key terms as follows:

- *Rights-holder*: has legal or customary tenure or use rights over land/water/resources within a proposed or confirmed [KBA](#);
- *Stakeholder*: may affect or may be affected by the outcome of the [KBA](#) identification and delineation process; all rights-holders are stakeholders, but not all stakeholders are rights-holders;
- *Consultation*: sharing information and seeking input;
- *Involvement*: working with rights-holders or other stakeholders to ensure their concerns and aspirations are understood, considered, and reflected in the alternatives developed;
- *Collaboration and consensus-building*: extends beyond consultation and involvement to building consensus and seeking agreement, where possible.

Stakeholder consultation and involvement are important at various stages of the [KBA](#) identification and delineation process, as summarised in Table 8.1. The three types of stakeholder consultation or involvement considered here will generally need to be conducted separately, unless the same individuals or organisations are involved:

- consultation with knowledge-holders (Section 8.1);

- consensus-building with proposers of existing KBAs (Section 8.2);
- involvement of customary rights-holders (Section 8.3).

Table 8.1 Stakeholder consultation required or recommended prior to KBA confirmation and publication on the KBA website

Who?	Type?	When?	What?
Biodiversity knowledge-holders	Consultation recommended ¹	Identification process	Information on biodiversity elements (species, assemblages, ecosystem types).
Tenure knowledge-holders	Consultation recommended ¹	Delineation process	Information on tenure, management, and use; manageability and boundaries.
Proposers of existing KBAs ²	Consensus-building required prior to modifying boundaries ^{3,4}	Delineation process	Boundaries.
Customary rights-holders (including Indigenous peoples, forest-dependent peoples, livestock-holders, fishers, etc.) ²	Involvement strongly recommended	Delineation process	Boundaries.
Customary rights-holders (as above)	Consent required	Before publication	Use of previously unpublished Indigenous and Local Knowledge (ILK) in KBA delineation. Publication or display of previously unpublished information regarding sacred natural sites.
Customary rights-holders (as above)	Involvement and consent strongly recommended	Before publication	Use of an Indigenous name for a KBA (except existing KBAs and official geographic names).
Customary rights-holders (as above)	Consensus-building required	After KBA identification and delineation	Informing active management. ⁵
Legal rights-holders (as above)	Consensus-building required	After KBA identification and delineation	Informing active management. ⁵
Additional stakeholders (including local communities, conservation and development organisations working in the region, local or national government agencies responsible for managing wildlife and natural areas in the region) ²	Involvement encouraged	After KBA identification and delineation	Informing active management. ⁵

Source: Compiled by the KBA SAC.

¹ Free, prior and informed consent (FPIC) is required prior to the publication or display of information based on unpublished Indigenous and Local Knowledge (ILK).

² These individuals or groups may also be included in biodiversity and/or tenure knowledge-holders.

³ Involvement is recommended but consensus-building is not required prior to adding new trigger biodiversity elements to an existing KBA.

⁴ If the proposer of an existing KBA is unwilling to modify boundaries so that it is not possible to delineate a KBA for additional trigger biodiversity elements or criteria without overlapping the existing KBA, then the KBA Proposer should involve the KBA NCG or KBA RFP (in that order) to try to find a mutually acceptable solution. If this process fails, then one or both parties may submit a KBA Appeal to the KBA Standards and Appeals Committee for a final binding decision.

⁵ While KBA identification and delineation do not include steps to advance active management, these rows are included here for consistency with the KBA Standard which states that “As the extent to which KBA boundaries inform active management increases, more extensive consultation will be needed, for example with Indigenous and local communities living in or near the site” (IUCN 2016, p. 26), as well as the Guidelines on Business and KBAs. These rows are shown in grey as a reminder that active management occurs after KBA identification and delineation and therefore falls beyond the remit of the KBA Standard and KBA Guidelines.

A brief final section (Section 8.4) addresses the statement in the **KBA Standard**: “As the extent to which **KBA** boundaries inform active management increases, more extensive consultation will be needed, for example with local and indigenous communities living in or near the **site**.” (IUCN, 2016, p. 26)

KBA NCGs are expected to play an important role in facilitating stakeholder consultation and involvement at the national level, and are encouraged to build good relationships with **biodiversity** knowledge-holders, socio-economic and cultural knowledge-holders and national organisations representing diverse sectors of society, including Indigenous peoples, local communities and resource users (e.g., forest-dependent peoples, farmers, pastoralists, fishers), and relevant government agencies.

8.1 Consultation with knowledge-holders

KBA Proposers are encouraged to consult with a range of local knowledge-holders to share knowledge during **KBA** identification and delineation. In particular:

- It is recommended that **KBA Proposers** invite **biodiversity** knowledge-holders (including taxonomic experts, biologists, and holders of **ILK**) to contribute their knowledge of the occurrence and distribution of **biodiversity elements** relevant to **KBA** identification and delineation. In many cases, it will not be possible to identify a **KBA** without this knowledge.
- **KBA Proposers** are encouraged to consult with proposers and managers of existing **KBAs** and other **sites** of biodiversity importance or protected or conserved areas in the area of interest, as they may well have relevant information on the occurrence and distribution of **biodiversity elements**.

- In regions with sensitive species, consultation with stakeholders knowledgeable about policies relating to sensitive species and associated data is also recommended.
- It is recommended that **KBA Proposers** invite local tenure and resource management knowledge-holders (including social scientists and holders of **ILK**) to share their knowledge of local legal and customary tenure and resource management systems and other information relevant to the delineation of practical **KBA** boundaries.

KBA Proposers are encouraged to contact relevant individuals and organisations directly. This may be supplemented by online consultation, where appropriate, but in many cases online consultation will not be an effective substitute for a direct approach. In many cases, consultation with **biodiversity** knowledge-holders and local tenure and resource management knowledge-holders will be separate processes, unless the same individuals and organisations are involved.

What is the role of Indigenous and Local Knowledge (ILK) in KBA identification and delineation?

Integrating **ILK** can improve **KBA** identification and delineation by ensuring that these are informed by the best available data, including data on species abundance and distribution patterns. In many cases, a **biodiversity element's range** may fall wholly or mostly within the territory of an Indigenous or local community; in others, **ILK** may need to be interpreted in the broader context of the species' or ecosystem's overall distribution. **ILK** can also play an important role in **KBA** delineation by ensuring that this is informed by the best available information on customary tenure and resource management systems.

Accessing **ILK** can be complex and will require different approaches in different communities. It is generally advisable to approach the leadership of the community first before going directly to particular knowledge-holders. This should be done with an understanding of the community's cultural practices, language(s) and traditions, in order to ensure any approach to an **ILK** knowledge-holder is done in a respectful, culturally appropriate manner, recognising they are equal partners in the information-sharing process. It is generally important to build trust with knowledge-holders, be open and transparent about how the information will be used, and consider issues relating to ownership of the information and permission to use the information (see below). The Intergovernmental Science-Policy Platform on Biodiversity and

Ecosystem Services (IPBES) [Approach to recognizing and working with indigenous and local knowledge](#) provides further guidelines on working with ILK.

Is Free, Prior and Informed Consent (FPIC) required to display KBAs on the KBA website?

The [KBA Proposer](#) is responsible for ensuring that [FPIC](#) is granted and documented before displaying information based on previously unpublished [ILK](#) on the [KBA website](#). Any [KBA](#) proposal that uses data derived from unpublished [ILK](#) must be flagged for expert review when the [KBA](#) proposal is submitted to the [WDKBA](#); [FPIC](#) should be documented (see the [KBA Proposal Process guidance](#)).

In rare cases, publication of information on [KBAs](#) could compromise the value of sacred natural sites (i.e. areas of land or water have special spiritual significance to peoples and communities, Verschuuren et al., 2010) if it encourages increased visitation. The [KBA Proposer](#) is therefore responsible for ensuring that [FPIC](#) is granted and documented before the publication or display of previously unpublished information regarding sacred natural sites, regardless of the information source. The location of sacred natural sites may not be widely known — it is therefore strongly recommended that [KBA Proposers](#) involve relevant [ILK](#)-holders, especially when working in regions where sacred natural sites may occur, to avoid revealing information on sacred natural sites inadvertently.

Is Free, Prior and Informed Consent (FPIC) required before using an Indigenous name for a KBA?

In regions that are important for Indigenous communities, using an Indigenous name may capture a [site's](#) local importance and have benefits in strengthening local support for the [KBA](#). [KBA Proposers](#) are strongly recommended to involve Indigenous peoples and ensure that [FPIC](#) is granted before using an Indigenous name for a proposed [KBA](#), especially if this is not the name of an existing [KBA](#) or the official name of a relevant geographic feature (e.g., the name of a mountain, lake or river used in maps produced by the national cartographic agency). (See the [KBA Proposal Process guidance](#) for further guidance on naming [sites](#) as [KBAs](#).)

How is consultation with knowledge-holders documented?

Any consultation with knowledge-holders during the [KBA](#) identification and delineation process should be documented. This is especially important if [FPIC](#) is required.

8.2 Consensus-building with proposers of existing KBAs

KBA Proposers are recommended to consult with proposers of existing **KBAs** (including **AZE sites**, **IBAs** and **KBAs** identified under previous initiatives) before updating site descriptions or any other information compiled by the previous proposers.

KBA Proposers are required to inform the proposers of existing **KBAs** of any proposed changes, including additions of **trigger biodiversity elements** or minor change to delineation (e.g., correcting a projection issue), and provide an explanation. It is also recommended that **KBA Proposers** inform site managers of any such changes.

Consensus-building with the proposers of existing **KBAs** is required before any **trigger biodiversity elements** are removed (e.g., following a **site-level** population decline) or if a significant change in delineation is proposed (for example, to accommodate additional **trigger biodiversity elements**, or because the existing **KBA** is not, or no longer, considered actually or potentially **manageable** as a unit). Mechanisms for contacting proposers of existing **KBAs** will be provided through the **WDKBA**, when it is fully functional.

What happens if proposers of existing KBAs in the area of interest cannot be contacted or do not respond?

As outlined in the **KBA Standard** (IUCN, 2016, p. 28), the aim is to avoid **KBA** boundaries that overlap with each other. **KBA Proposers** are required to make a genuine attempt to build consensus with proposers of existing **KBAs** that may overlap with newly proposed **KBAs**. If efforts to contact proposers of existing **KBAs** or resolve overlaps are unsuccessful, then **KBA Proposers** should involve the **KBA NCG** or **RFP** (in that order).

What happens if proposers of existing KBAs in the area of interest are unwilling to modify them to accommodate additional trigger biodiversity elements or criteria?

If proposers of existing **KBAs** are unwilling to modify **site** boundaries so that it is not possible to delineate **KBAs** for additional **KBA trigger biodiversity elements** or additional criteria without overlapping an existing **KBA**, then **KBA Proposers** should involve the **KBA NCG** or **KBA RFP** (in that order) to try to find a mutually acceptable solution.

How is consensus-building with proposers of existing KBAs documented?

KBA Proposers should provide text briefly summarising the process and outcomes of consensus-building with proposers of any existing **KBAs** that may overlap with a newly proposed **KBA** when submitting a **KBA** proposal as part of the delineation rationale (see the **KBA Proposal Process guidance**). This text should provide enough information for the **KBA NCG**, **KBA RFP** and the **KBA Secretariat** to understand and assess the decision and rationale.

8.3 Involvement of customary and legal rights-holders

The process of **KBA** identification and delineation does not directly affect the customary or legal ownership/management/use rights of any rights-holders because **KBA** identification and delineation does not include any steps to advance management activity.

Nevertheless, involvement of customary rights-holders is strongly recommended during the **KBA** identification and delineation process because **KBAs** can provide the basis for future conservation and management actions. Customary rights-holders need to be in a position to shape and anticipate this momentum early on, so they can be involved as they wish in decision-making about future management activities. This is especially important in situations where customary rights do not have legal backing and/or Indigenous people or other natural resource-dependent communities are typically marginalised in decision-making processes. **FPIC** will generally be required before any steps are made to advance management activities that might affect the rights of Indigenous people and other natural resource-dependent communities (see Section 8.4).

Involvement of legal rights-holders (including land/water/resource owners, managers and users), protected area managers and government agencies responsible for conservation and management of land, water, and other natural resources is also encouraged because it engages them in the process and can help with identification of practical **KBA** boundaries.

Customary and legal rights-holders may also serve as **biodiversity** knowledge-holders or tenure knowledge-holders (see Section 8.1).

How can involvement of customary rights-holders be achieved?

In many countries, customary rights-holders are represented at the national level by various national bodies, such as organisations or networks for Indigenous or forest-

dependent peoples, livestock-holders, fishers, etc. Where this is the case, involvement of customary rights-holders may be facilitated by seeking advice from representative organisations or networks, including advice on how best to reach out to customary rights-holders for particular [sites](#). In most cases, however, involvement of customary rights-holders will take place at the local level.

How is involvement of customary or legal rights-holders documented?

In countries or regions with Indigenous peoples or other customary rights-holders, [KBA Proposers](#) should check relevant maps (if available) or with relevant government or non-government organisations to determine whether potential [KBAs](#) overlap with any Indigenous territories or areas subject to customary tenure. This information should then be included in KBA proposals.

Any involvement of customary or legal rights-holders during the [KBA](#) identification and delineation process should be documented for future reference. In each case, [KBA Proposers](#) should provide text briefly summarising involvement efforts and outcomes. This text should provide enough information for the [KBA NCG](#) and [KBA RFP](#) to understand and assess what was done.

8.4 Beyond KBA identification and delineation

Guidance on stakeholder consultation and involvement relating to active management falls beyond the remit of the [KBA Guidelines](#). Here, we note that the [IUCN Policy on Conservation and Human Rights for Sustainable Development](#) includes the guiding principle that [FPIC](#) is required when IUCN projects, activities, and/or initiatives take place on Indigenous peoples' lands and territories and/or impact natural and cultural resources, sites, assets, etc. More specifically, the [IUCN Standard on Indigenous Peoples](#) includes the following principle: "Indigenous peoples are consulted and are active and effective participants in decision-making processes relevant to them and related to conservation activities supported by IUCN. [Free, Prior and Informed Consent \(FPIC\)](#) is obtained for any intervention affecting their rights and access to their lands, territories, waters and resources." More generally, there is a responsibility to involve any natural resource-dependent communities, including forest-dependent peoples, farmers, pastoralists and fishers, when considering conservation or management actions that might affect their rights. The [Guidelines on Business and KBAs](#) include the following recommendation: "The establishment of an inclusive and transparent stakeholder and right-holder engagement process (including, for example, representatives of national, regional, and

local government; indigenous peoples; local communities; and other elements of civil society) in planning and decision making is recommended. International best practices for stakeholder and right-holder engagement, including a rights-based approach and **Free, Prior, and Informed Consent (FPIC)** for engaging with indigenous and traditional peoples and local communities, are implemented as early as possible in the project cycle and follow recognised best practices.”

9. Data availability, quality and uncertainty

The [KBA Standard](#) (IUCN, 2016, p. 5) states: “The [KBA](#) criteria have quantitative [thresholds](#) to ensure that [site](#) identification is transparent, objective and repeatable. It is important to compile the best available data for [KBA](#) identification, but the availability of high quality data differs significantly between different [taxonomic groups](#)...”

The [KBA Standard](#) (IUCN, 2016, p. 7) states that: the data used to support [KBA](#) identification and delineation “...must be traceable to a reliable source and be recent enough to give confidence that the [biodiversity elements](#) are still present given the history of land use [and other types of] change in an area.”

9.1 Data availability

Global estimates of the number of [mature individuals](#), [range](#), [ESH](#), and [AOO](#), if available, will be pre-filled in the [WDKBA](#) when it is fully functional.

Do data used in KBA identification and delineation need to be published?

In the case of [global](#) estimates of assessment parameters that are not derived from [IUCN Red List](#) or [Red List of Ecosystems](#) assessments and have not been published previously, [KBA Proposers](#) should document how these parameters were estimated so that the method can be reviewed and updated in the future.

[KBA Proposers](#) are responsible for ensuring that data used to estimate [site](#)-level values of assessment parameters, or to observe or infer the [ecological integrity](#) of a [site](#), are referenced to a publication, are publicly available (e.g., through a free data-archiving service such as the [Dryad Digital Repository](#)), or are made available on request. In the latter case, a brief description of the data and data source and contact details for the data-holder should be included in the [KBA](#) proposal; this information can then be cited as *in litt.* (See the [KBA Proposal Process guidance](#) for more detailed guidance on required and recommendation documentation to support [KBA](#) identification and delineation.)

9.1.1 Sensitive data

How are sensitive data treated?

In some cases, publication of [KBAs](#) or information on species distribution patterns on the [KBA website](#) or [Integrated Biodiversity Assessment Tool \(IBAT\)](#) could put the

biodiversity values of those sites at risk. For example, publication of information on the localities of remaining populations of a rare species may jeopardise its conservation.

A sensitive data flag may apply to any species with an IUCN Red List account published since 2004 that does not include a range map or locality data and to any species with a range polygon coded “Generalised = 1” (see Appendix III.1 for additional information). KBA Proposers should check with their KBA RFP, who will liaise with the IUCN Red List Unit, before submitting a KBA proposal for these species.

KBA Proposers should also follow these principles adapted from the Sensitive Data Access Restrictions Policy for the IUCN Red List. A sensitive data flag should be applied to species that:

- (a) are listed as CR or EN on the IUCN Red List under Criteria C and D, or have not been assessed for the IUCN Red List but would likely qualify as CR or EN under Criteria C and D;
- (b) have high economic value;
- (c) are listed or would likely be listed as threatened by trade; and
- (d) have important sites that are not generally known (e.g., an internet search engine such as Google cannot find these sites).

Given that the KBA website provides more detailed information on the distribution of many species than the IUCN Red List, a more precautionary approach is appropriate for KBAs. Therefore, trigger species may also be flagged as sensitive if:

- the species has a small global population size in the wild and is known to be exploited, collected, traded or utilised, resulting in the death or permanent removal of individuals from the wild (or belongs to a group of species that is exploited in this way); or
- the species is threatened by widespread, unregulated exploitation of wild populations, resulting in the death or permanent removal of individuals from the wild;

and:

- the species has a life history that cannot sustain or recover easily from over-exploitation;

and:

- the proposed site is not generally known to hold a significant population of the species.

It is recommended that **KBA Proposers** include information about sensitive **trigger** species in **KBA** proposals, but flag any species as sensitive if it meets the criteria set out above and there are concerns about publishing the information provided. Information included in **KBA** proposals on sensitive **trigger** species will be made available to the **KBA Secretariat** (including **KBA RFPs**) and possibly to **IBAT** subscribers, but will not be published on the **KBA website**. If **KBA Proposers** have any concerns about sharing sensitive data, they are asked to discuss these with their **RFP**.

9.2 Data quality

9.2.1 Observing and inferring the proportion of the global population size at a site

For some of the species-based criteria (i.e. A1, B1-3), the proportion of the **global population size** at a **site** may be *observed* or *inferred* based on one or more assessment parameters. For D1-3, the proportion of the **global population size** at a **site** may be *observed* based on the number of **mature individuals**.

How can the proportion of the global population size at the site be “observed”?

The **population size** at a **site** may be *observed*¹⁷ from well documented recent direct observations of **mature individuals** (e.g., the number of sea lion females observed nursing sea lion pups at a **site**). Animal tracking data collected using devices with high location accuracy (e.g., global positioning system, GPS) and camera traps are considered equivalent to direct observations.

Population size may be based on counts of all **mature individuals** at a **site** or on counts of **mature individuals** in representative sampling areas (e.g., points, transects, quadrats) together with statistical assumptions about sampling (e.g., point sampling, distance sampling). Any statistical assumptions regarding the representativeness of sampling or detectability should be justified in the documentation. Statistical habitat models may be needed if densities within the site vary as a function of topographical or environmental covariates (see Appendix III.2). **Site population size** estimates based on sampling may be subject to expert review.

How can the proportion of the global population size at the site be “inferred”?

The proportion of the **global population size** at a **site** may be *inferred* based on indirect evidence, such as indices of the relative abundance of **mature individuals** (e.g., the

¹⁷ Note that the definition of “observed” here includes the definition of “estimated” in the IUCN Red List Guidelines (IUCN SPC 2022, Section 3.1).

number of sea lion pups at a [site](#) may serve as an index of the abundance of [mature individuals](#)), or using the area-based assessment parameters (e.g., [AOO](#), [ESH](#), [range](#), or number of [localities](#)), as indicated for each criterion in the [KBA Standard](#). Inference is generally based on biological assumptions about the relationship between observed variables (e.g., sea lion pups) or modelled output (e.g., [ESH](#)) and the variable of interest (i.e. number of [mature individuals](#)). Animal tracks may be inferred from analysis of data from low-accuracy geolocators (e.g., light-level loggers). Any biological or statistical assumptions should be justified in the documentation.

How recent do data need to be when used to observe or infer the proportion of the global population size or global extent of an ecosystem type at a site, or ecological integrity?

Estimates of abundance and distribution are likely to become less accurate over time. Data that were collected more than 8-12 years before the assessment should be used cautiously and only if there is no information suggesting that there has been significant relevant change in [global](#) or [site-level population size](#) or distribution patterns (i.e. a change likely to affect [KBA](#) qualification or delineation). Thus, for example, older data may be acceptable in a remote wilderness area that has seen little change in the last 50 years, but not in one that has seen recent extensive habitat transformation, or where [trigger](#) species may have suffered significant decline due to factors such as disease, invasive species, or over-exploitation.

See Section 9.2.3 below for confirmation of presence.

[9.2.2 Known, inferred and projected occurrences](#)

[Range](#) is defined as the current known limits of distribution of a species, accounting for all *known, inferred* or *projected* sites of occurrence (IUCN, 2012a).

What are “known sites of occurrence”?

“Known” sites of occurrences are known [localities](#) based on well documented recent direct observations (i.e. recent enough to give confidence that the [biodiversity elements](#) are still present, given the history of land-use change in an area, see IUCN, 2016, p. 7), excluding vagrancies.

Note that the confirmed presence of proposed [trigger](#) species is required for all [sites](#) identified as [KBAs](#) under species-based criteria, except for species listed as CR (PE) or CR(PEW) at [sites](#) where they trigger [KBA](#) Criterion A1e (see Section 2.4.5).

What are “inferred sites of occurrence”?

“Inferred” refers to the use of information about habitat characteristics, dispersal capability, rates and effects of habitat destruction and other relevant factors (such as exploitation), based on known **localities**, to deduce a very high likelihood of presence (IUCN SPC, 2022, Section 4.10.7).

Note that inferred occurrences may be used to estimate the proportion of the **global population size** found at a **site**, but a **KBA** must include at least one known **locality** (i.e. confirmed presence, see Section 9.2.3).

What are “projected sites of occurrence”?

“Projected” refers to spatially predicted occurrences based on habitat maps or models (IUCN SPC, 2022, Section 4.10.7).

Any projected occurrences beyond the spatial extent of known **localities** (as defined by a minimum convex polygon based on known **localities**) should have a very high likelihood of presence, based on known **localities** and the species’ dispersal capability.

When used to estimate **AOO**, projected occurrences are subject to the three conditions outlined in Appendix III.

Note that projected occurrences may be used to estimate the proportion of the **global population size** found at a **site**, but a **KBA** must include at least one known **locality** (i.e. confirmed presence, see Section 9.2.3).

9.2.3 Confirmation of presence and reproductive units

For all **sites** proposed as **KBAs**, with the exception of **sites** identified under subcriterion A1e for species listed as CR (PE) or CR (PEW), the presence of the **KBA trigger biodiversity elements** at the **site** must be confirmed and documented (see the **KBA Proposal Process guidance**). This is especially important where **KBA** identification relies on area-based parameters (i.e. **AOO**, **ESH**, or **range**).

How can presence be confirmed for species that are listed as Critically Endangered (Possibly Extinct) or Critically Endangered (Possibly Extinct in the Wild)?

In the case of CR (PE) or CR (PEW) species, the proposed **KBA** should be the **site** where the species is most likely to occur, if it still exists. **KBA Proposers** should confirm that adequate habitat persists at the **site** and explain why the species may have escaped detection if it still exists. For example, a reasonable case may be made for a species with cryptic morphology, ecology or behaviour making it difficult to detect (such as a

plant for which viable seed may persist in the soil seed bank, or an elusive invertebrate that is adapted to a certain hostplant which is still present).

What types of data can be used to confirm species presence?

Wherever possible, confirmation of species presence should be based on direct observations of **mature individuals**. Animal tracking data collected using devices with high location accuracy (e.g., GPS), photographic data (whether collected in-person, by drone or camera trap) and acoustic data (identifiable to species) are considered equivalent to direct observations.

For cryptic species, indirect observations (e.g., scat, tracks, burrows, or environmental DNA that can be identified unambiguously to species) may be used to infer presence. Clear justification should be given in the documentation for using indirect evidence. Presence cannot be inferred simply from the presence of habitat, or habitat maps or models, with the exception of CR (PE) or CR (PEW) species under subcriterion A1e.

What types of data can be used to confirm that the reproductive-units threshold is met?

Wherever possible, confirmation that the **reproductive-units threshold** is met should be based on direct observations of the required number of **reproductive units** or **mature individuals**. Where this is not possible, some forms of inference may be used as described below:

(i) *Direct observations:* Animal tracking data collected using devices with high location accuracy (e.g., GPS) and photographic data (collected in-person, by drone or camera trap) are considered equivalent to direct observations.

(ii) *Indirect observations:* Indirect evidence of the minimum number of **reproductive units** or **mature individuals** may be used for cryptic species (e.g., active burrows indicating the threshold number of breeding pairs). Presence of immature individuals may be used if parental care is required (e.g., presence of pups for seals) or if both mature and immature individuals are sedentary (e.g., presence of tadpoles for frogs or toads).

(iii) *Information in the IUCN Red List account indicating that the species likely occurs in numbers that exceed the reproductive-units threshold at the site:* For example, the species is described as "abundant", "common" or "frequent" at the **site**. (Note that relevant information may be found in sections on Geographic Range, Population, Habitat and Ecology, or Conservation Actions.)

(iv) *Inference based on continuous presence:* The species has been present at the site for multiple generations and the **site population size** is not declining, indicating ongoing successful reproduction.

(v) *Inference based on the number of mature individuals at the site:* A reproductive unit is defined as 1 or 2 mature individuals and the minimum population size regularly held at the site is estimated at ≥ 100 mature individuals (or ≥ 50 mature individuals for 5 reproductive units);

(vi) *Inference based on the proportion of the global population size held at the site together with the species' IUCN Red List category and criteria:* In some cases, the proportion of the **population size** estimated to occur at the **site**, together with the species' **IUCN Red List** category and criteria indicate that it is unlikely that the **site** holds fewer than the threshold number of **reproductive units** or **mature individuals**. It can be inferred that a **site** holds at least 10 **reproductive units** in the following circumstances:

a) the **site** regularly holds effectively the entire **global population size** of a species listed as VU, Near-Threatened (NT) or Least Concern (LC);

b) a **reproductive unit** is defined as 1 or 2 **mature individuals** and the species has been assessed as EN (but not under **IUCN Red List** Criterion D), indicating a minimum **global population size** of at least 250 **mature individuals**, and the site holds at least 40% of known **localities** or **AOO** (for 5 reproductive units);

c) a **reproductive unit** is defined as 1 or 2 **mature individuals** and the species has been assessed as VU (but not under **IUCN Red List** Criterion D1), NT or LC, indicating a minimum **population size** of at least 1,000 **mature individuals**, and the site holds at least 20% of known **localities** or **AOO**.

(vii) *Inference based on geographically separate occurrences:* If occurrence records represent observations of **mature individuals** and the species is sedentary, territorial or otherwise of limited mobility (such that it is unlikely that different occurrences represent the same individuals), then the minimum number of **reproductive units** at the **site** may be inferred from the number of known geographically separate occurrences at the **site**. The definition of “geographically separate” will depend on the mobility of **mature individuals** and other relevant aspects of the behaviour, ecology and reproductive system of the species and should guide the number and spatial dispersion of known occurrences required

to infer that the **reproductive-units threshold** is met. This definition should be justified in the documentation.

Inference (i.e. iv–vii above) should *not* be used to assess the **reproductive-units threshold** under KBA Criteria A1a, A1c or B1 for species listed as CR based on **IUCN Red List** Criterion D, indicating that the **global population size** is fewer than 50 mature individuals.

The **reproductive-units threshold** cannot be inferred from the presence of habitat or from habitat maps or models alone (i.e. without any data on abundance at the site). Inference should not be based on **range** or **ESH**, except for (v a), as **range** and **ESH** may be unoccupied. Any inference should include confirmation that adequate habitat exists at the **site** to support the species in numbers meeting or exceeding the **reproductive-units threshold** and that there is no reason to expect that the species does not occur at the **site** in such numbers (for example, as a result of pressure from hunting, fishing, invasive predators or competitors, inadequate prey, disease).

How recent do data need to be when used to confirm species presence or reproductive units at a site?

The data used to confirm presence and the number of **reproductive units** (where required) should be recent – ideally collected within the last 8-12 years before **KBA** identification.

Older data should be used conservatively, especially for species listed as **globally threatened** under **IUCN Red List** Criterion A2, A3 or A4, for other species known to have suffered recent population declines, or if the **site** has suffered significant habitat loss or other types of degradation in the intervening period. Clear justification should be given in the documentation for using older data, up to a maximum of 50 years (except for CR (PE) or CR (PEW) species).

Data older than 50 years may only be used to confirm the presence of species at **sites** where the species triggers subcriterion A1e and the species has not been assessed as CR (PE) or CR (PEW). **KBA Proposers** should confirm that adequate habitat persists at the **site** and explain why the species may have escaped detection if it still exists. The logic for allowing older data in this context is as follows: If a **site** is thought to hold effectively the entire **global population size** of a species, but the species has not been listed as CR (PE) or CR (PEW) even though it has not been observed at the site for more than 50 years, it can be inferred that the **IUCN Red List** assessors believe the species still occurs at the **site**. If older data were not allowed in this context, then it

would not be possible to confirm any [site](#) as a [KBA](#) for some CR or EN species that would otherwise trigger subcriterion A1e. This would be contrary to the intent of the [KBA Standard](#) and inconsistent with the guideline that [KBAs](#) can be identified under subcriterion A1e for species listed as CR (PE) or CR (PEW) without confirmation of presence.

Surveys to confirm the presence of [trigger biodiversity elements](#) should be conducted during the 8-12 years between initial [KBA](#) confirmation and reassessment and between reassessments, so that presence can be confirmed based on recent data at the time of reassessment. Data used to confirm presence and [reproductive units](#) (where required) in [KBA](#) reassessments should not be older than 8-12 years unless the justification for older data is very strong and it is very unlikely that the species has been extirpated.

How are presence and reproductive units documented?

Confirmation of presence and that the number of [reproductive units](#) at a [site](#) meets the relevant [threshold](#) (where required) should, ideally, be referenced to a publication or other publicly available data source (e.g., [IUCN Red List](#) account, a peer-reviewed journal article or publicly available site monitoring report).

Where this is not possible, for options (i)-(iv) above (under *What types of data can be used to confirm that the reproductive-units threshold is met?*), the knowledge of one or more named biodiversity knowledge-holders may be used instead. Biodiversity knowledge-holders should have sufficient expertise to provide reliable confirmation of species identification. Ideally, the biodiversity knowledge-holder(s) will have made a recent visit to the site, but expert review of data recently collected at the site may also be used. In particular, species that are challenging to identify in the field may be confirmed later through expert verification of specimens, photographs, video or other evidence collected at the [site](#). Experts should provide a brief explanation of the data used to confirm presence and/or that the number of [reproductive units](#) meets the [threshold](#) (see examples in Appendix VIII).

For option (v) above, it is only necessary to indicate the basis for inference (e.g., with a reference to (a), (b), (c), (d), or (e)), as calculations can be made automatically in the [WDKBA](#) when it is fully functional.

For each proposed [trigger](#) species, [KBA Proposers](#) should provide a statement that:

- a) confirms that the species has recently been observed at the site with a brief explanation of the data used (e.g., “field observations of **mature individuals** at the **site**”, “GPS tracking of **mature individuals**”, “eDNA collected at the **site**”);
- b) by a named biodiversity knowledge-holder who can provide reliable confirmation of species identification;
- c) in numbers that meet or exceed the **reproductive-units threshold** (where required);
- d) with a brief description of how **reproductive units** (where required) are defined for the species;
- e) the year of observation;
- f) a reference (e.g., publication, locality database, named biodiversity knowledge-holder with contact details).

What types of data can be used to confirm presence of an ecosystem type?

See Sections 4.3.4 and 4.4.4.

9.3 Uncertainty

9.3.1 Types of uncertainty

There are two main types of uncertainty that may affect **KBA** identification:

- *Measurement uncertainty*, such as uncertainty about the true number of **mature individuals** at any point in time, can often be reduced by collecting more data (for example, by increasing the sample size or number of sampling occasions) using appropriate sampling, measurement and estimation methods.
- *Ecological variation* (often called “process variation”), such as interannual variation in the true number of **mature individuals** at a **site**, can be a source of uncertainty as to whether a **site** qualifies as a **KBA**, even if the number of **mature individuals** is counted precisely each year.

9.3.2 Dealing with uncertainty

In many cases, the **population size** at a **site** will be either well above or well below the **threshold** for qualification as a **KBA**. Uncertainty is only significant for **KBA** identification when the estimated **site-level population size** lies close to the relevant **threshold**, such that there is uncertainty about whether or not the **site** qualifies. For example, if the minimum **site-level population-size** estimate exceeds the relevant **threshold** based on the maximum **global population-size** estimate, then the **site** would qualify as a **KBA** regardless of uncertainty.

In the process of identifying sites that contribute significantly to the global persistence of biodiversity, it is important to balance the risks of omission and commission errors, i.e. the risks of failing to identify a site that actually qualifies (omission error) and the risks of identifying a site that does not actually qualify (commission error). High rates of omission error may lead to biodiversity loss, but high rates of commission error could deflate the value of identifying KBAs and may dilute conservation resources.

Note that the low thresholds for Criteria A1 and A2 relative to the other criteria provide a built-in precautionary approach to identifying sites of importance for globally threatened species and ecosystem types.

How to deal with measurement uncertainty?

The general principle for handling measurement uncertainty is to balance the risks of omission and commission error. In the context of measurement uncertainty, a site should be proposed if it is more likely than not that it meets the relevant threshold. For example, if the global population size is 10,000 mature individuals, and the site-level population size is most likely greater than 1,000 individuals, then the site population most likely exceeds a 10% threshold. In other words, the site would qualify if there was a greater than 50% chance that it exceeds 1,000 mature individuals. Consider the data summarised in Table 9.3.2.1 – in this case, the site would qualify because the median estimate exceeds the threshold (i.e. there is a greater than 50% chance that the site population exceeds the threshold). The determination of whether a site is more likely than not to meet the relevant threshold may be based on quantitative or qualitative analysis (e.g., a statistical analysis or an expert-based weighing of various types of evidence).

Table 9.3.2.1 Example of measurement uncertainty. The true number of individuals is not observed directly; rather, the estimated number is based on counts by three observers. The site population-size threshold in this example is 1,000 mature individuals.

	Unknown true number	True number ≥ threshold?	Observer 1	Observer 2	Observer 3	Median count	Median count ≥ threshold?
Year 1	1,100	✓	1,060	1,032	876	1,032	✓

Source: Compiled by the KBA SAC.

Measurement uncertainty may occur at both **global** and **site** levels. If no **global** estimate of the chosen assessment parameter is provided in the **WDKBA**, **KBA Proposers** will be asked to provide the best estimate of the assessment parameter at both **global** and **site** levels. The same type of estimate should be used at both **global** and **site** levels for comparison. Where there is a choice, the order of preference is as follows: maximum likelihood estimate, “best”, median, mean, midpoint of the maximum and minimum.¹⁸

If the only data available are presence/absence data, then **KBA Proposers** will need to infer the proportion of the **global population size** at the **site** based on one of the area-based assessment parameters, which include number of **localities**.

How to deal with ecological variation?

Ecological variation (e.g., fluctuations in a species’ **population size** or the **extent of ecosystem type** attributable to random environmental variation) is distinct from long-term trend (see Section 3.1 for guidance on handling trends). It likely occurs to some extent for all species at all **sites**, as well as for dynamic **ecosystem types** (e.g., kelp forests). Ecological variation is often substantial for **sites** important for **biological processes**, such as demographic **aggregations** (D1), **ecological refugia** (D2) and recruitment sources (D3).

The general principles for handling ecological variation are based on the application of Ramsar Criteria 5 and 6 (Ramsar, 2018). A **site** **predictably** holds the **threshold population size** if the following conditions are met:

- (i) Interannual variation: the number of **mature individuals** at the **site** is known to have met or exceeded the **threshold population size** in at least two thirds of the years for which adequate data are available for the relevant season (e.g., the breeding season in the case of a breeding **aggregation**); the total number of years considered should not be fewer than three; or
- (ii) Intra-annual variation: the mean of the maximum number of **mature individuals** at the **site** during the relevant season meets or exceeds the **threshold population size**; the mean should be taken over at least five years.¹⁹

For example, adult female marine turtles return to specific nesting beaches to lay their eggs, but, in most cases, individual females do not return every year, so that the

¹⁸ If necessary, the maximum likelihood, “best” and median can be compared to each other. The mean should only be compared to the maximum likelihood, “best” or median if measurement error is limited. The mid-point of the maximum and minimum should not be compared to the other metrics.

¹⁹ Note that the mean may be used here, instead of the median, for consistency with the Ramsar criteria.

number of nesting females that use a **site** over a breeding season can vary substantially from one year to the next. Suppose the **site threshold** under Criterion D1a is 1,000 mature females. Under (i) above, the **site** would be considered to **predictably** hold 1,000 mature females during the nesting season if it holds 1,000 mature females in at least two thirds of nesting seasons. Consider the data set out in Table 9.3.2.2. The **site** would qualify under D1a because the **site** exceeds **threshold** numbers in two out of three years.

Table 9.3.2.2 Ecological variation. The site population-size threshold in this example is 1,000 mature individuals (females).

	True number	True number \geq threshold ?
Year 1	700	✘
Year 2	1,100	✓
Year 3	1,200	✓
Site qualifies?		✓

Source: Compiled by the KBA SAC.

For example, during the dry season, large flocks of a particular waterfowl species move among several distinct wetlands depending on prey availability, so that the number of **mature individuals** counted at a particular wetland can vary substantially from one day to the next as well as interannually. (The wetlands are too far apart to be **manageable** as a unit.) The **population-size threshold** for this species under Criterion D1a is 1,000 **mature individuals**. Consider the data set out in Table 9.3.2.3, comprising counts of **mature individuals** on a number of survey days each year over six years. Under (ii) above, the **site** would qualify under D1a because the mean of the maximum number of **mature individuals** counted at the **site** during the dry season over the six years with available data exceeds the **population-size threshold**.

Table 9.3.2.3 Ecological variation. The site population-size threshold in this example is 1,000 mature individuals.

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Maximum count
Year 1	880	170	152	30	1,529	357	1,529
Year 2	522	107	82	58	281		522
Year 3	316	216	828	2,378			2,378
Year 4	55	26	129	61	827	308	827
Year 5	746	2,122	1,405	521	731		2,122
Year 6	92	1,413	205	84	1,587	47	1,587
Mean							1,494

Source: Compiled by the KBA SAC.

How to deal with ecological variation and measurement uncertainty combined?

In some cases, ecological variation is combined with measurement uncertainty. Returning to the marine turtle example, consider the data set out in Table 9.3.2.4. Based on the observer estimates, the **site** would be recognised as qualifying under D1a, despite measurement uncertainty, because the median observer count exceeds **threshold** numbers in two out of three years (i.e. it is considered more likely than not the **site** exceeds **threshold** numbers in two out of three years).

Table 9.3.2.4 Ecological variation and measurement uncertainty combined. The true number of individuals is not observed directly; rather, the estimated number is based on counts by three observers. The site population-size threshold in this example is 1,000 mature individuals.

	Observer r 1	Observer r 2	Observer r 3	Median count	Median count ≥ threshold ?
Year 1	787	676	791	787	✘
Year 2	1,060	1,032	876	1,032	✓
Year 3	1,102	1,081	1,172	1,102	✓
Site qualifies?					✓

Source: Compiled by the KBA SAC.

What happens if different assessment parameters point to different conclusions?

See Section 3.1.

10. Reassessment

The term “reassessment” is used synonymously with the term “re-evaluation” throughout the [KBA Guidelines](#).

Confirmed [KBAs](#) should be reassessed against the [KBA](#) criteria and [thresholds](#) at least once every 8-12 years, although more frequent monitoring of [KBAs](#) is recommended wherever possible. If the original [KBA Proposer](#) is no longer available, the [KBA NCG](#) or [KBA RFP](#) (in that order) may identify a group to work on reassessment.

Reassessment of [sites](#) identified as [KBAs](#) is especially important in the context of climate change, as climate change may affect [biodiversity](#) to such an extent that a [site](#) increases in importance and qualifies under additional criteria or loses importance and ceases to qualify.

The reassessment process also presents a good opportunity to check whether there are any additional species or [ecosystem types](#) that might trigger [KBA](#) status at the [site](#).

10.1 Reasons for a change in KBA status

Why might the status of a confirmed KBA change?

The focus here is on changes in the status of confirmed [KBAs](#) and delisting of [KBAs](#). [KBA Proposers](#) or [KBA NCGs](#) may also decide to reassess [sites](#) that almost qualified in previous [KBA](#) identification processes, but information on [sites](#) that do not qualify is not stored in the [WDKBA](#), so that process is not covered here.

A [site](#) that has been confirmed as a [KBA](#) may change status for one or more of the following reasons:

- A. *KBA criteria revision*: for example, a [site](#) that qualified under previous [KBA](#) criteria does not qualify under the current [KBA Standard](#) (e.g., Version 1.0);
- B. *taxonomic change*: for example, a species is reclassified as a [subspecies](#);
- C. *change in threat category*: for example, a species or [ecosystem type](#) was reassessed for the [IUCN Red List](#) or [Red List of Ecosystems](#) and is now listed under a different category or set of criteria;
- D. *new or more reliable information*: for example, better estimates of a species’ [global population size](#) or the [extent of an ecosystem type](#) that [regularly](#) occurs at the [site](#), including corrections to erroneous data or analysis; reclassification of a species so that it is no longer [restricted-range](#), or [ecoregion-](#) or [bioregion-](#)restricted;

- E. *genuine change*: for example, a reduction in the proportion of a species' **global population size** or number of **reproductive units**, or the **extent of an ecosystem type** that **regularly** occurs at the **site**; a reduction in **ecological integrity**. Genuine changes may be classified as (i) attributable primarily to factors relating to **site** management (e.g., habitat degradation at the **site**), or (ii) primarily to factors operating beyond the **site** (e.g., overexploitation of a migratory species elsewhere in its **range**, shifts in the distribution of an **ecosystem type** driven by global climate change);
- F. *change in the site boundary or manageability*: for example, the **site** is redelineated because it is not (or no longer) considered to be actually or potentially **manageable** as a unit (e.g., because an existing **KBA** was originally proposed without taking **manageability** into account; or following a change in a management unit boundary or jurisdiction).

The reasons for any change in status should be documented (see the **KBA Proposal Process guidance**).

10.2 Frequency of reassessment

How often should confirmed KBAs be reassessed?

The **KBA Standard** (IUCN, 2016, p. 7) states that **KBAs** should be reassessed against the criteria and **thresholds** at least once every 8-12 years. An 8-12-year window was selected as a practical compromise; it encourages a shorter reassessment timeframe (8 years is ideal), while recognizing that it will often take longer and some flexibility will be needed (12 years is the maximum).

For each **KBA trigger biodiversity element**, the baseline for the 8-12 year window is the previous assessment for that element, not the year when data were collected. A **site** will be retained in the **WDKBA** after 12 years, but flagged as “needs updating”. A confirmed **KBA** will not lose its **KBA** status solely on the basis of old data or the need for reassessment.²⁰

Earlier updates to documentation and reassessment, if appropriate, is encouraged in the case of:

- a *taxonomic change* to a **trigger** species;
- a *change in threat category* of a **trigger** species or **ecosystem type** for a **site** confirmed as a **KBA** under Criterion A1 or A2.

²⁰ New data showing that the site does not qualify would be required in any KBA Appeals process.

Earlier reassessment is also encouraged if:

- *new information* becomes available
- a **site** suffers a catastrophic event (i.e. a *genuine change*) leading to the irreversible loss of a **trigger** species or **ecosystem type** or to loss of a **site's ecological integrity**.

Earlier reassessment is required if:

- there is a *change to the site boundary*.

Ideally, all **trigger biodiversity elements** will be reassessed at the same time on 8-12 year cycles, even if some have been added more recently. Interim reassessments of particular species (e.g., following a *taxonomic change*, *change in threat category*, or *new information* affecting a particular species) can be conducted individually without reassessing all other **trigger biodiversity elements**.

What about AZE sites, IBAs or other KBAs identified under previously published criteria?

AZE sites, IBAs or other **KBAs** identified under previously published criteria that are shown to meet the criteria and **thresholds** in the **KBA Standard**, and for which minimum documentation requirements have been met, will be recognised as **global KBAs**. Those that may meet **global KBA** criteria and **thresholds**, but for which the data have not yet been compiled to demonstrate the case, will be flagged as “global/regional status not yet determined” and considered a priority for update. Those that do not meet **global KBA** criteria and **thresholds** but which do meet previously established regional criteria and **thresholds** will be recognised as regional **KBAs**. The start date for the 8-12 year reassessment period for **AZE sites**, IBAs or other **KBAs** identified under previously published criteria is the publication date of the **KBA Standard** (i.e. April 2016).

10.3 Reassessment process

What does KBA reassessment involve?

During the reassessment process, **KBA NCGs** or **KBA Proposers** should use the following checklist:

- For **sites** that were confirmed as a **KBA** under any of the species-based criteria (i.e. A1, B1-3, D1-3, E), check whether there have been any taxonomic changes to **trigger** species (see Section 2.2.1).

- For **sites** that were confirmed as a **KBA** under Criterion A1 or A2, check whether there has been any change in the threat category of the **trigger species** or **ecosystem type**, such that the **site** no longer qualifies as a **KBA** under Criterion A1 or A2.
- For each **KBA trigger biodiversity element**, check whether there has been a change in the **global** or **site-level** values of assessment parameters (e.g., based on new or more reliable information), such that the **biodiversity element** no longer meets relevant **thresholds**.
- For each **KBA trigger biodiversity element**, reconfirm the **KBA trigger biodiversity element's** presence at the **site**, in numbers that meet or exceed the **reproductive-units threshold**, where applicable. It is recommended that data used to confirm presence in **KBA** reassessments under any of the criteria should not be older than 8-12 years.
- For each confirmed **KBA**, check whether there have been any changes in **manageability** or other changes indicating that **KBA** delineation should be revisited. This is especially important for **sites** considered potentially rather than actually **manageable** as a unit during the original **KBA** delineation. Any outstanding overlaps with other **KBAs** should also be addressed during reassessment.

During the reassessment process, **KBA NCGs** and **KBA Proposers** are also strongly encouraged to check whether any additional species or **ecosystem types** might trigger a **KBA** at the **site**.

How are KBAs identified under Criterion C reassessed?

For **sites** identified as **KBAs** under Criterion C, confirm that the site still represents an example of outstanding **ecological integrity** at the **global** scale. Reassessment will generally follow similar lines to the original assessment (e.g., in terms of the set of **ecological integrity** indicators), but may expand on the original assessment if additional relevant data are available.

How are KBAs identified under Criterion E reassessed?

For **sites** identified as **KBAs** under Criterion E, reassessment needs to be conducted at the network level, as **irreplaceability** is the property of a **site** within a network rather than an individual **site** in isolation (see Section 6). Reassessment may be based on the same geographic extent and taxonomic scope and methods as the original assessment. In this case, reassessment will generally involve a review of datasets and species representation targets followed by re-analysis. However, **KBA Proposers** are encouraged to expand the taxonomic scope if newly available data allow for the

inclusion of additional species. **KBA Proposers** are also encouraged to check the set of recommended decision support tools (Section 6.2.5) and update the methods used, if appropriate.

What happens if a KBA no longer qualifies because of a genuine increase in the global population size?

(i) Effective conservation of a **trigger** species at a **KBA** may contribute to an increase in the **global population size**. In that case, the proportion of the **global population size** held at the **site** would be expected to increase. The **KBA** would only lose its status if successful conservation of a **globally threatened trigger** species led to its downlisting on the **IUCN Red List** and a change in the relevant **KBA** criteria or **thresholds** (e.g., **KBA Criterion A1** no longer applies). In this case, the **site** should be reassessed against all the **KBA** criteria to clarify its status. The **site** may be highlighted as a conservation success on the **IUCN Green List**, subject to meeting the **IUCN Green List** criteria.

(ii) Effective conservation of a **trigger** species elsewhere in its **range** may also contribute to an increase in the **global population size**. The proportion of the **global population size** held at the **site** may decrease and/or a **globally threatened trigger** species may be downlisted on the **IUCN Red List**, leading to a change in the relevant **KBA** criteria or **thresholds**. In this case, the **site** should be reassessed against all the **KBA** criteria to clarify its status. If it no longer qualifies under any **global KBA** criteria, it will no longer be a **global KBA**, but may still qualify as a regional **KBA** following guidelines for regional application of the **KBA** criteria and **thresholds** (to be developed in due course).

What happens if a KBA no longer qualifies because of a genuine reduction in site-level population size?

The reassessment process may indicate that a **site** no longer qualifies as a **global KBA** because of a *genuine reduction* in the site-level **population size**, ecosystem extent or **ecological integrity**. If this reduction could be reversed in the next 8-12 years through proposed restoration activities, the **site** will be flagged as “restoration dependent” in the **WDKBA** to allow for restoration. The **KBA NCG** or **KBA Proposer** should review the **site’s** status in two years. If restoration activities are not underway by that time, the **site’s** change in status will be confirmed (i.e. after two years). If restoration activities are underway but do not enable the **site** to recover its **KBA** status by the next reassessment, then the change in status will be reviewed and confirmed at that time (i.e. after 8-12 years).

Conversely, if the reduction in the [site-level population size](#), ecosystem extent or [ecological integrity](#) is unlikely to be reversed through proposed restoration activities in the next 8-12 years (i.e. before the next reassessment), the [site](#) should be reassessed against all the [KBA](#) criteria to clarify its status. The [site's](#) change in status will be indicated in the [WDKBA](#) immediately after it has been reviewed and confirmed and on the [KBA website](#) at the next update. If the [site](#) no longer qualifies under any [global KBA](#) criteria, it will no longer be a [global KBA](#), but may still qualify as a regional [KBA](#) following guidelines for regional application of the [KBA](#) criteria and [thresholds](#) (to be developed in due course).

How should changes in the status of KBA be documented?

See the [KBA Proposal Process guidance](#).

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Appendix I: Definitions of terms used in the KBA criteria

The terms used in the [KBA Standard](#) (IUCN, 2016) must be clearly understood to ensure that the [KBA](#) criteria are applied correctly. The following terms are defined in the [KBA Standard](#) (IUCN, 2016, pp. 9-15). In the text below, definitions taken verbatim from the [KBA Standard](#) are shown in black; additional clarifications are shown in grey.

I.1 Terms used in defining KBAs

Key Biodiversity Areas (KBAs)

KBAs are sites contributing significantly to the global persistence of biodiversity.

Biodiversity

Biodiversity is “the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems”, according to the [Convention on Biological Diversity \(CBD\)](#) (UN, 1992).

Contributing/Contribution

The **contribution** of a **site** to the **global persistence** of **biodiversity** depends on the **global** distribution and the abundance of the **biodiversity elements** for which the **site** is important. **Sites** holding **biodiversity elements** that are **globally** restricted, or at risk of disappearing, make high **contributions** to the **persistence** of those elements. The **global persistence** of a **biodiversity element** occurring at any given **KBA**, unless it is entirely confined to the **site**, depends not only on the fate of the **site** itself but also on that of other **sites** and of the land-/seascapes where it occurs.

Global

Global implies that the **contributions** of a **site** to the **persistence** of a given **biodiversity element** are measured in relation to its worldwide **population size** or extent.

Persistence

Persistence of a **biodiversity element** means that its loss (e.g., species extinction, ecosystem collapse) or decline (e.g., of numbers of **mature individuals** of a species, ecosystem **extent** and condition) is avoided, both now and into the foreseeable future.

Significantly/Significant

Significant means that an outstanding proportion of a **biodiversity element** (e.g., species **population size** or ecosystem **extent**) occurs at the **site**, as defined by a quantitative **threshold**.

Site

A geographical area on land and/or in water with defined ecological, physical, administrative or management boundaries that is actually or potentially **manageable** as a single unit (e.g., a protected area or other managed conservation unit). For this reason, large-scale biogeographic regions such as **ecoregions**, Endemic Bird Areas and Biodiversity Hotspots, and land-/seascapes containing multiple management units, are not considered to be **sites**. In the context of **KBAs**, “**site**” and “**area**” are used interchangeably.

I.2 Terms used in the KBA criteria and delineation procedures

Aggregation (Criterion D)

A **geographically restricted** clustering of individuals that typically occurs during a specific life history stage or process such as breeding, feeding or migration. This clustering is indicated by highly localised relative abundance, two or more orders of magnitude larger than the species’ average recorded numbers or densities at other stages during its life-cycle.

The **KBA Standard** refers to a difference in relative abundance of two or more orders of magnitude, but this is advisory rather than required. Other metrics may also be used to support **KBA** proposals under Criterion D1 (e.g., nearest-neighbour distances).

Area of occupancy (Criteria A, B, E)

The area within the **range** of a species that is actually occupied (IUCN, 2012a).

AOO is the area of habitat that is occupied by the species, based on known, inferred and projected occurrences (IUCN 2001). This definition does not include old localities

where the species is no longer known, inferred or projected to be present as a result of habitat transformation or other factors likely to have caused the species' extirpation, such as disease, invasive species or over-exploitation.

This definition also excludes localities with a single record or sporadic occurrence outside the species' habitat or beyond the species' dispersal range from known, inferred or projected occurrences, such that the species is not expected to occur regularly at the locality.

Assemblage (Criterion B)

A set of species within a **taxonomic group** having: a) their **ranges** $\geq 95\%$ **predictably** confined to a single **ecoregion** for at least one **life-history stage**; b) their **ranges** $\geq 95\%$ **predictably** confined to a single biome for at least one **life-history stage** (for **taxonomic groups** with a global median **range** size $> 25,000$ km²); or c) their most important habitats in common with multiple other species.

In the definition of "assemblage", the term "biome" should be replaced by the term "bioregion". This will be corrected in the next version of the **KBA Standard**.

For species with validated **ESH** maps, **ESH** may be substituted for **range**.

The term "assemblage" is also used in the definition of "ecological integrity", but in a more generic sense.

Biodiversity element

Genes, species or ecosystems, as used by the **Convention on Biological Diversity (CBD)** definition of **biodiversity** (Jenkins, 1988).

Biological process (Criterion D)

The demographic and **life-cycle processes** that maintain species such as reproduction and migration.

Bioregion (Criterion B)

Major regional terrestrial and aquatic habitat types distinguished by their climate, flora and fauna, such as the combination of terrestrial biomes and biogeographic realms (Olson et al., 2001) or marine provinces (Spalding et al., 2007, Spalding et al., 2012). These biogeographic units are typically about an order of magnitude larger in area than the **ecoregions** nested within them.

Bioregion templates for terrestrial, freshwater and marine systems are currently being evaluated and will be provided in Appendix V in due course.

Complementarity (Criterion E)

A measure of the extent to which an area contains elements of **biodiversity** not represented, or that are underrepresented, in an existing set of areas; alternatively, the number of unrepresented or underrepresented **biodiversity elements** that a new area adds to a network (Margules & Pressey, 2000).

Distinct genetic diversity (Criteria A, B)

The proportion of a species' genetic diversity that is encompassed by a particular **site**. It can be measured using Analysis of Molecular Variance or similar technique that simultaneously captures diversity and distinctiveness (frequency of alleles and the genetic distinctiveness of those alleles).

Ecological integrity (Criterion C)

A condition that supports **intact** species **assemblages** and ecological processes in their natural state, relative to an appropriate historical benchmark, and characterised by contiguous natural habitat with minimal direct industrial anthropogenic disturbance.

Ecoregion (Criteria B, C)

A "relatively large unit of land (or water) containing a distinct assemblage of natural communities and species with boundaries that approximate the original extent of natural communities prior to major land-use change" (Olson et al., 2001). Ecoregions have been mapped for terrestrial (Olson et al., 2001), freshwater (Abell et al., 2008) and near-shore marine (Spalding et al., 2007) environments and are nested within **bioregions** or provinces.

Please see Appendix V for **ecoregion** templates for terrestrial, freshwater and marine systems.

Ecosystem type (Criteria A, B)

A defined ecosystem unit for standard and repeatable assessment, at an intermediate level in a globally consistent ecosystem classification hierarchy such as macrogroup or equivalent (Faber-Langendoen et al., 2014). It is defined by a particular set of variables related to its characteristic native biota, an abiotic environment or complex, the interactions within and between them, and a physical space in which these operate (Keith et al., 2013, Rodríguez et al., 2015). Other terms such as "ecological

communities” and “biotopes” are often considered operational synonyms of **ecosystem type**.

In the IUCN Global Ecosystem Typology, **biogeographic ecotypes** (Level 4) and **global ecosystem types** (Level 5) are considered the relevant levels for **KBA** identification (see the IUCN Global Ecosystem Typology Ver. 2.0, Table 2 for further details).

The **KBA Standard** also allows for **KBAs** triggered by equivalent **ecosystem types**, defined using other globally consistent ecosystem classification hierarchies (e.g., EcoVeg, Faber-Langendoen et al., 2014). For consistency with the definition of **ecosystem type** in the **KBA Standard** (see above) and the ecosystem concept used in the **Red List of Ecosystems**, equivalent **ecosystem types** should be defined by a particular set of variables related to the characteristic native biota, abiotic environment or complex, the interactions within and between them, and a physical space in which these operate (Keith et al., 2013, Rodríguez et al., 2015).

Endemic (Criteria A, E)

A species having a **global range** wholly restricted to a defined geographic area such as a region, country or **site**.

Environmental stress (Criterion D)

Natural events like floods, droughts, storms, wildfires, earthquakes as well as high or low temperature caused by global change; it can also describe the lack of food due to the bottom-up effect of **environmental stress** or massive die off of prey in ecosystem due to infectious disease.

Environmental stress refers to extreme environmental conditions, whether natural or anthropogenic.

Extent of suitable habitat (Criteria A, B)

The area of potentially suitable ecological conditions, such as vegetation or substrate types within the altitudinal or depth, and temperature and moisture preferences, for a given species (Beresford et al., 2011).

ESH refers to the area of habitat available to a species within its **range**. **ESH** cannot extend beyond the **range**, but may include unoccupied habitat within the species’ **range**, unlike **AOO**.

ESH is broadly defined to include habitat maps based primarily on expert knowledge (deductive models) or statistical analysis (inductive models). **ESH** thus includes both

the concept of “area of habitat” (AOH), which focuses on deductive models (Brooks et al. 2019), and output from statistical habitat models. (See Appendix III.2 for further discussion.)

Geographically restricted (Criterion B)

A biodiversity element having a restricted global distribution, as measured by **range**, **extent of suitable habitat** or **area of occupancy**, and hence largely confined or **endemic** to a relatively small portion of the globe such as a **bioregion**, **ecoregion** or **site**.

Intact ecological community (Criterion C)

An ecological community having the complete complement of species known or expected to occur in a particular **site** or ecosystem, relative to a regionally appropriate historical benchmark, which will often correspond to pre-industrial times.

Irreplaceability (Criterion E)

Either (a) the likelihood that an area will be required as part of a system that achieves a set of **targets** (Ferrier et al., 2000) or (b) the extent to which the options for achieving a set of **targets** are reduced if the area is unavailable for conservation (Pressey et al., 1994). **Irreplaceability** is heavily influenced by **geographically restricted biodiversity**, but it is a property of an area within a network rather than of an element of **biodiversity** and is related to the concept of **complementarity**.

Locality (Criteria A, B)

A sampling **locality** is a point indicated by specific coordinates of latitude and longitude. Note that the term “**locality**”, as defined here, is fundamentally and conceptually different from the term “**location**” used in the **IUCN Red List** (IUCN, 2012a).

Localities refer to known points of occurrence, and do not include inferred or projected occurrences or sampling points where the species was not found to occur. For the purposes of **KBA** identification, old records from areas where the species no longer occurs and vagrancies (i.e. records from areas where the species has only been recorded sporadically and is not known to be native) are excluded from known **localities**.

Each **locality** should represent a discrete population, to the extent this can be inferred, given the degree of habitat fragmentation and what is known about the dispersal capabilities of the species.

Manageability (Delineation)

The possibility of some type of effective management across the **site**. Being a **manageable site** implies that it is possible to implement actions locally to ensure the **persistence** of the **biodiversity elements** for which a **KBA** has been identified. This requires that **KBA** delineation consider relevant aspects of the socio-economic context of the **site** (e.g., land tenure, political boundaries) in addition to the ecological and physical aspects of the **site** (e.g., habitat, size, connectivity).

An additional aspect of **manageability** is **site** accessibility. In some cases, the scale of **manageability** will be determined by how large an area can be monitored in practice, given the configuration of roads or waterways or the range of typical survey vessels.

Mature individuals (Criteria A, B, E)

The number of individuals known, estimated or inferred to be capable of reproduction as defined in IUCN (2012a).

Population size (Criteria A, B, D)

The total, **global**, number of **mature individuals** of the species (IUCN, 2012a). Population size is used throughout the **KBA Standard** rather than simply “population”, which IUCN, (2012a) use to mean the total number of individuals of a species.

In the **KBA Guidelines**, the term “**population size**” is used to refer to the total number of individuals in a species, as in “**global population size**”; and to the number of individuals in a geographically or otherwise distinct group, as in the “**site population size**”. This differs from the **IUCN Red List**, in which the term “subpopulation” is used to refer to a geographically or otherwise distinct group in the population (IUCN, 2012a).

Predictably (Criterion D)

An expectation of species occurrence at a **site** during particular seasons or at one or more stages of its life cycle, based on previous or known occurrence, such as in response to specific climate conditions.

Predictable occurrence includes both regular (seasonal) occurrence and irregular (episodic) occurrence, as long as the occurrence is a predictable response to environmental conditions.

For Criterion D1, which is based on regular (seasonal) occurrence, a [site](#) “predictably” holds a species if the species is known to have occurred at the [site](#) in at least two thirds of the years for which adequate data are available for the relevant season (e.g., the breeding season in the case of a breeding [aggregation](#)); the total number of years considered should not be fewer than three. This is consistent with the definition of “regularly” in the application of Ramsar Criteria 5 and 6 (Ramsar, 2018). (See Section 9.3.2 for detailed guidelines.)

In contrast, Criterion D2 is based on irregular (episodic) occurrence. The term “predictably” is not used in Criterion D2, but consistent with D1 and D3, a [site](#) may be considered to hold a species during periods of [environmental stress](#) if the species is known to have occurred at the [site](#) in at least two thirds of the periods of [environmental stress](#) for which adequate data are available. (There is no minimum number of periods of [environmental stress](#) given here, as periods of [environmental stress](#) are generally rare events.)

Range (Criterion A, B, E)

The current known limits of distribution of a species, accounting for all known, inferred or projected sites of occurrence (IUCN, 2012a), including conservation translocations outside native habitat (IUCN SPSC, 2014)²¹ but not including vagrancies (species recorded once or sporadically but known not to be native to the area).

The term “range” is not defined in the [IUCN Red List Categories and Criteria](#) (IUCN 2012a), but the definition of “range” in the [KBA Standard](#) is consistent with the term’s use in [IUCN Red List](#) assessments and in the [IUCN Red List Mapping Standards](#).

[Range](#) thus describes the geographic limits of distribution within the major system(s) in which a species occurs, after removing large areas of absence resulting from unsuitable physical geography (e.g., altitude, bathymetry, hydrology), climate or habitat.

For the purposes of [KBA](#) identification, [range](#) explicitly includes areas where a species has been introduced for conservation purposes outside its native habitat, as these are included in [IUCN Red List](#) assessments.

²¹ Note that IUCN SPSC (2014) has been updated to IUCN SPS (2019).

Regularly (Criteria A, B)

The occurrence of a species is normally or typically found at the **site** during one or more stages of its life cycle.

A **site “regularly”** holds a species if the species is either continually present or occurs there on a predictable cyclical basis, typically (but not necessarily) following a seasonal pattern. In the case of seasonal occurrence, a **site “regularly”** holds a species if it is known to have occurred there in two thirds of the years for which adequate data are available for the relevant season (e.g., the breeding season in the case of a breeding aggregation); the total number of years considered should not be fewer than three. This is consistent with the definition of “regularly” in the application of Ramsar Criteria 5 and 6 (Ramsar, 2018).

Reproductive unit (Criteria A, B, E)

The minimum number and combination of **mature individuals** necessary to trigger a successful reproductive event at a **site** (Eisenberg, 1977). Examples of five **reproductive units** include five pairs, five reproducing females in one harem, and five reproductive individuals of a plant species.

Additional examples of five **reproductive units** include:

- birds: 5 active nests; 5 pairs; or 5 mature females and at least 1 mature male in lekking species;
- amphibians: 5 mature females and at least 1 mature male for most species; 5 pairs for species that provide biparental care;
- turtles: 5 mature females for marine turtles on nesting beaches;
- fish: 5 mature females and at least 1 mature male for most species; 5 pairs for species that form bonded pairs (e.g., some seahorse species);
- insects: 5 females and at least 1 male for non-social insects; 5 colonies with a single reproducing queen each for social insects; 5 reproductive females for parthenogenetic insects;
- cooperative breeders: 5 cooperative units (e.g., 5 packs of African Wild Dog, *Lycaon pictus*);
- fungi: 5 **mature individuals**;
- plants: 5 **mature individuals** for self-fertilising monoecious or hermaphroditic species;
- clonal species: 5 distinct clones.

Restricted range (Criterion B)

Species having a **global range** size less than or equal to the 25th percentile of **range-size** distribution in a **taxonomic group** within which all species have been mapped globally, up to a maximum of 50,000 km². If all species in a **taxonomic group** have not been mapped globally, or if the 25th percentile of **range-size** distribution for a **taxonomic group** falls below 10,000 km², **restricted range** should be defined as having a **global range** size less than or equal to 10,000 km². For coastal, riverine and other species with linear distributions that do not exceed 200 km width at any point, **restricted range** is defined as having a **global range** less than or equal to 500 km linear geographic span (i.e. the distance between occupied locations [i.e. **localities**] farthest apart). Species known only from their type **locality** should not automatically be assumed to have a **restricted range**, since this may be indicative of under-sampling. For species that have been assessed for the **IUCN Red List**, information on whether the species is likely to occur more widely, should be available in the **IUCN Red List** account.

Note that **range**, not **ESH**, must be used for identifying **restricted-range** species.

The minimum **threshold** for **restricted range** is set at 10,000 km² as a precautionary measure.

A list of all species that have been assessed for the **IUCN Red List** that qualify as **restricted-range** (using the 10,000 km² **threshold** for any **taxonomic group** that has not yet been comprehensively assessed) is provided on the **KBA website (Tools page)**.

Target (Criterion E)

A conservation target is the minimum amount of a particular **biodiversity** feature for which conservation is desirable through one or multiple conservation actions (Possingham et al., 2006).

Taxonomic group (Criterion B)

Taxonomic ranks above the species level.

A standard list of **taxonomic groups for applying Criteria B2 and B3** is provided on the **KBA website (Tools page)**.

Threatened (Criterion A)

Assessed through globally standardised methodologies as having a high probability of extinction (species) or collapse (ecosystems) in the medium-term future. Threatened

species are those assessed as Critically Endangered (CR), Endangered (EN), or Vulnerable (VU) according to The [IUCN Red List of Threatened Species™](#) (IUCN, 2012a). For the purposes of [KBA Criterion A1](#), Threatened also includes species assessed as regionally/nationally CR, EN or VU using the [IUCN Red List Categories and Criteria](#) (IUCN, 2012b) that (a) have not been assessed [globally](#) and (b) are [endemic](#) to the region/country in question. Threatened ecosystems are those assessed as CR, EN or VU according to the [IUCN Red List of Ecosystems](#) (IUCN, 2015).

The [IUCN Red List of Ecosystems Categories and Criteria](#) (Version 2.0) were established as a standard by IUCN (2014), based on Keith et al. (2013), not by “IUCN (2015)” as erroneously cited in the [KBA Standard](#). The formatting (but not the content) of these has been updated in the two versions of the [RLE Guidelines](#) produced to date (Bland et al., 2016, 2017).

Threshold (Criteria A-E)

Numeric or percentage minima which determine whether the presence of a [biodiversity element](#) at a [site](#) is [significant](#) enough for the [site](#) to be considered a [KBA](#) under a given criterion or subcriterion.

Trigger (Criteria A-E)

A [biodiversity element](#) (e.g., species or ecosystem) by which at least one [KBA](#) criterion and associated [threshold](#) is met.

I.3 Additional terms

The following terms defined here were not defined in the [KBA Standard](#).

Biogeographic ecotype (Criteria A, B)

[Biogeographic ecotypes](#) (Level 4) are defined as: “An ecoregional expression of an ecosystem functional group derived from the top down by subdivision of Ecosystem functional groups (Level 3). They are proxies for compositionally distinctive geographic variants that occupy different areas within the distribution of a functional group.” (See the [IUCN Global Ecosystem Typology](#) Ver. 2.0, Table 2 for further details.)

Ecological refugium (Criterion D)

In the [KBA Standard](#) (IUCN, 2016), [ecological refugia](#) are [sites](#) that maintain necessary resources (such as food and water) during periods of [environmental stress](#) (such as

severe droughts) when conditions elsewhere become inhospitable, sometimes over multiple years or decades.

Note that the [KBA Standard](#) states that [ecological refugia](#) are used in times of [environmental stress](#). Sites where individuals concentrate in times of environmental plenty (e.g., when prey is available at unusually high densities) do not meet this definition.

Extent of an ecosystem type (Criteria A, B)

[Extent of an ecosystem type](#) refers to the current geographic distribution of an [ecosystem type](#), representing all spatial occurrences of the [ecosystem type](#) (Bland et al., 2017, p. ix).

Equivalent system (Criterion A)

[Equivalent systems](#) refers to regional- or national-based assessment processes that produce [global](#) status assessments that: i) are based on similar criteria to the [IUCN Red List](#) and can be reliably cross-walked to the [IUCN Red List](#); ii) set similar standards for minimum supporting documentation and involve an appropriate process of independent review; and iii) are implemented by recognised assessment bodies in the region/country in question, based on science and input from scientists/experts throughout the entirety of each species' [range](#). (See Appendix VII for further details.)

Global ecosystem type (Criterion B)

[Global ecosystem types](#) are defined as: “A complex of organisms and their associated physical environment within an area occupied by an ecosystem functional group. [Global ecosystem types](#) grouped into the same ecosystem functional group share similar ecological processes, but exhibit substantial difference in biotic composition. They are derived from the bottom up, either directly from ground observations or by aggregation of subglobal types (Level 6).” (See the [IUCN Global Ecosystem Typology Ver. 2.0](#), Table 2 for further details.)

Life-history function (Criterion D)

See [life-cycle process](#).

Life-history stage (Criterion D)

In the **KBA Standard**, including the definition of “aggregation”, the term “life-history stage” is intended to be synonymous with “life-cycle process” and does not refer to developmental stage (e.g., egg, chick, juvenile, adult).

Life-cycle process (Criterion D)

Life-cycle process refers to a period in a species’ life-cycle when some or all members of a population perform essential activities such as spawning/mating, feeding, moulting, migration (see also **biological processes**). For many species, these **life-cycle processes** occur at predictable **sites** in predictable seasons. Criterion D1 applies to species that **aggregate** in particular **sites**, generally for specific **life-cycle processes** during a specific season.

To reduce ambiguity, the **KBA Guidelines** refer to “life-cycle processes” throughout and avoid the terms “life-history function” or “life-history stage”, except when quoting directly from the **KBA Standard**.

Micro-organisms

The **KBA** criteria were not designed for application to **micro-organisms** (IUCN, 2016, p. 4). For the purposes of **KBA** identification, **micro-organisms** are defined as unicellular organisms or organisms that form colonies of cells without specialised tissues, including archaea, bacteria, and unicellular eukaryotes.

Recruitment source (Criterion D)

In the **KBA Standard** (IUCN 2016), a **recruitment source** is a **site** that produces abundant propagules, larvae or juveniles that disperse out of the **site** and have a high probability of surviving to maturity, thus contributing to recruitment elsewhere.

Vagrant

Individual of a species recorded once or sporadically but known not to be native to the area (IUCN, 2016).

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Appendix II: Summary of the KBA criteria and thresholds

A. Threatened biodiversity		
<i>A1 Threatened species</i>		Assessment parameters
A1a	≥0.5% of global population size and ≥5 reproductive units (RU) of a CR/EN species	(i) no. of mature individuals (ii) area of occupancy (iii) extent of suitable habitat (iv) range (v) no. of localities (vi) distinct genetic diversity
A1b	≥1% of global population size and ≥10 RU of a VU species	
A1c	≥0.1% of global population size and ≥5 RU of a species listed as CR/EN due only to past/current decline [= Red List A only, but not A3 only]	
A1d	≥0.2% of global population size and ≥10 RU of a species listed as VU due only to past/current decline [= Red List A only, but not A3 only]	
A1e	Effectively the entire population size of a CR/EN species	
<i>A2 Threatened ecosystem types</i>		
A2a	≥5% of global extent of a CR or EN ecosystem type	
A2b	≥10% of global extent of a VU ecosystem type	
B. Geographically restricted biodiversity		
<i>B1. Individual geographically restricted species</i>	≥10% of global population size and ≥10 RU of any species	(i) no. of mature individuals (ii) area of occupancy (iii) extent of suitable habitat (iv) range (v) no. of localities (vi) distinct genetic diversity
<i>B2. Co-occurring geographically restricted species</i>	≥1% of global population size of each of a number of restricted-range species in a taxonomic group: ≥2 species or 0.02% of the total number of species in the taxonomic group, whichever is larger	
<i>B3. Geographically restricted assemblages</i>		
B3a	≥0.5% of global population size of each of a number of ecoregion-restricted species in a taxonomic group: ≥5 species or 10% of the species restricted to ecoregion, whichever is larger	(i) no. of mature individuals (ii) area of occupancy (iii) extent of suitable habitat (iv) range (v) no. of localities
B3b	≥5 RU of ≥5 bioregion-restricted species or ≥5 RU of 30% of the bioregion-restricted species known from the country, whichever is larger	
B3c	Site is part of the globally most important 5% of occupied habitat for ≥5 species in the taxonomic group	(i) relative density of mature individuals (ii) relative abundance of mature individuals
<i>B4. Geographically restricted ecosystem types</i>		
	≥20% of the global extent of an ecosystem type	
C. Ecological integrity		
	Site is one of ≤2 per ecoregion with wholly intact ecological communities	composition and abundance of species and interactions
D. Biological processes		
<i>D1. Demographic aggregations</i>		
D1a	≥1% of global population size of a species, over a season, and during ≥1 key stage in life cycle	no. of mature individuals
D1b	Site is among largest 10 aggregations of the species	no. of mature individuals
<i>D2. Ecological refugia</i>	≥10% of global population during periods of environmental stress	no. of mature individuals
<i>D3. Recruitment sources</i>	Produces propagules, larvae or juveniles maintaining ≥10% of global population size	no. of mature individuals
E. Irreplaceability through quantitative analysis		

Appendix III: Estimating range, extent of suitable habitat (ESH) and area of occupancy (AOO)

Appendix III.1 provides guidelines on estimating **range**, Appendix III.2 on estimating **extent of suitable habitat (ESH)**, and Appendix III.3 on estimating **area of occupancy (AOO)**. Appendix III.2 includes a section on *Validation* that is relevant to all habitat maps or models used in **KBA** assessments.

III.1 Range

Existing data on range

For species that have been assessed for the **IUCN Red List**, **range** polygons can be downloaded from the **IUCN Red List** account²².

If the **IUCN Red List** account for a species assessed since 2004 does not include a **range** map or **locality** data, this may indicate that distribution data for the species are considered sensitive. **KBA Proposers** should also check whether **range** polygons are coded “Generalised = 1”; if so, this also indicates that the **range** polygon has been generalised and that distribution data for the species are considered sensitive. In both cases, **KBA Proposers** should review Section 9.1.1 on sensitive data and check with their **KBA RFP**, who will liaise with the **IUCN Red List Unit**, before submitting a **KBA** proposal for these species. **Range** estimates derived from a generalised polygon should not be used as an assessment parameter in **KBA** identification.

With the exception of species listed as CR (PE) or CR (PEW), **KBA Proposers** should use the **range** map in the **IUCN Red List** assessment coded as follows:

- Presence = 1 (Extant) and 2 (Probably Extant)²³;
- Origin = 1 (Native) and 2 (Reintroduced) and 6 (Assisted Colonisation); and

²² Individual range maps for non-commercial use can be downloaded from IUCN Red List species accounts; whole groups may be downloaded from <http://www.iucnredlist.org/technical-documents/spatial-data>; and custom-built sets using a free Red List user account.

²³ Note that Presence = 2 is deprecated and will be discontinued. Any range maps that include areas coded as Presence = 2 that extend beyond known occurrences should be reviewed carefully and updated if appropriate prior to KBA identification. Range polygons coded as Presence = 3 (Possibly Extant), Presence = 4 (Possibly Extinct), Presence = 5 (Extinct) or Presence = 6 (Presence Uncertain) should be excluded.

- any Season code (see below for migratory species).

Select the polygons with the codes listed above to calculate total **range** area, or breeding and non-breeding **range** area. (See the [IUCN Red List Mapping Standards](#) for detailed definitions of mapping codes.)

Migratory species

For migratory species that have distinct breeding and non-breeding **ranges** identified in [IUCN Red List](#) assessment maps, breeding and non-breeding **ranges** will typically be assessed separately.

Proposers should use the area of the **range** coded as follows for the **breeding range**:

- Presence = 1 (Extant) and 2 (Probably Extant)²⁴;
- Origin = 1 (Native) and 2 (Reintroduced) and 6 (Assisted Colonisation); and
- Seasonality = 1 (Resident) and 2 (Breeding Season) and 5 (Seasonal Occurrence Uncertain).

Proposers should use the area of the **range** coded as follows for the **non-breeding range**:

- Presence = 1 (Extant) and 2 (Probably Extant)²⁵;
- Origin = 1 (Native) and 2 (Reintroduced) and 6 (Assisted Colonisation); and
- Seasonality = 1 (Resident) and 3 (Non-breeding Season) and 5 (Seasonal Occurrence Uncertain).

Species listed as CR (PE) or CR (PEW)

For species listed as CR (PE) or CR (PEW), [KBA Proposers](#) may use polygons coded as Presence = 3 (Possibly Extant) and coded for Origin and Seasonality as above.

[KBA Proposers](#) are encouraged to reach out to [IUCN Red List](#) assessors if the presence coding for species listed as CR (PE) or CR (PEW) is unclear.

Estimating range

If there is no **range** map for a species or the **range** map needs updating, please see the [IUCN Red List Mapping Standards](#) for detailed guidelines on developing distribution maps for estimating **range**.

In the documentation, [KBA Proposers](#) are requested to include sufficient information on datasets and mapping procedures to enable reproduction of the **range** map, and

²⁴ See previous footnote.

²⁵ See previous footnote.

describe the process whereby the **range** map was created (including the degree of expert engagement). The final **range** map should also be submitted as a shapefile to the **KBA Secretariat** for archiving. This file may then be provided to other **KBA Proposers** for use in future **KBA** proposals (with a reference to the original spatial data source).

III.2 Estimating extent of suitable habitat (ESH)

Habitat maps show the distribution of habitat for a species and are used as the basis for estimating **ESH**.

ESH is the area of potentially suitable ecological conditions for a species within the species' current **range** (see Fig. 3.6). Typically, **ESH** takes into account a species' observed altitudinal/bathymetric limits or preferences, other observed physiological limits or preferences (e.g., temperature, salinity), and major habitat types (e.g., land cover, or benthic habitat), as appropriate.

ESH is broadly defined to include habitat maps based primarily on expert knowledge (deductive models) or statistical analysis (inductive models). **ESH** thus includes both the concept of "area of habitat" (AOH), which focuses on deductive models (Brooks et al., 2019), and output from statistical habitat models (also referred to as species distribution models, ecological niche models, bioclimatic models, density distribution models, etc.)

Deductive approaches are well suited to developing consistent binary habitat maps for entire **taxonomic groups**, including data-limited species. They have lower data, technical and computational demands than inductive approaches.

Deductive approaches are well suited to sedentary species and species with fixed breeding and/or non-breeding habitats. They are not well suited to species with spatially dynamic habitats, including many pelagic marine species. For such species, inductive approaches based on statistical habitat models provide the best available methods for estimating the distribution of **mature individuals**, if sufficient data are available.

Existing data on ESH

Validated **ESH** maps, derived using a deductive approach, are available for terrestrial mammals and birds (Dahal et al., in press) and will be provided through the **IUCN Red List** (spatial downloads page). Validated **ESH** maps for other taxonomic groups will also be provided when available.

Estimating ESH

If there is no validated **ESH** map or there is scope for improving the existing **ESH** map, the first step for **KBA Proposers** seeking to use **ESH** as an assessment parameter is to download the existing **range** map or develop a new **range** map (see Appendix III.1).

Spatial resolution

An **ESH** map is typically a raster (i.e. set of grid cells), but may be a polygon. If **ESH** is based on grid cells, the proportion of a species' **ESH** that is found within a **site** will depend in part on the spatial resolution of analysis. Analysis at a finer spatial resolution (for example, using 1-km² or 4-km² grid cells rather than 100-km² grid cells) will generally lead to a lower **global ESH** and make it more likely that a **site** that falls entirely within the **ESH** exceeds the **thresholds** specified in the criteria. The standard resolution for **AOO** is 2 × 2 km grid cells; a link to a standardised 2 × 2 km grid is provided on the **KBA website** (Tools page). **KBA Proposers** are encouraged to use this grid for **ESH** where appropriate, but may use other resolutions if the 2 × 2 km grid is not suitable given the species' distribution patterns or the resolution of available data.

Deductive approaches

Deductive approaches, such as AOH (Brooks et al. 2019), typically involve classifying topographical and environmental data layers (e.g., altitude, bathymetry, land cover and benthic habitats, distance to water bodies), using information on altitudinal limits and habitat classes in **IUCN Red List** accounts (see **IUCN Red List Habitat Classification Scheme**) derived from published and unpublished literature and expert knowledge.

A similar approach may be used in marine systems, especially for relatively sedentary benthic or demersal species, using bathymetry and other physiological limits (e.g., sea-surface temperature and salinity) together with benthic habitat classes.

Once a **range** map is available, **ESH** can be delimited as follows:

- i. in a GIS, rasterise the **range** map into grid cells (optional);
- ii. remove cells or areas that fall outside the altitudinal/bathymetric or climate/temperature/salinity/soil type limits of the species distribution;
- iii. remove cells or areas that are otherwise unlikely to be suitable for the species, based on land cover or benthic habitat.

Inductive approaches

ESH maps may also be developed using inductive approaches, by applying statistical methods (e.g., generalized linear or additive models, classification or regression trees) to known **localities** and topographical and environmental covariates (Elith & Leathwick, 2009; Franklin, 2010; Zurell et al., 2020).

Statistical habitat models are generally used to estimate (a) the probability of occurrence of the species, and/or (b) the expected relative abundance or densities (e.g., in terms of numbers of individuals or biomass) based on correlation between known **localities** and topographical/environmental covariates. A **threshold** may be used to generate a binary habitat map (e.g., an **ESH** map) by selecting areas with high probability of occurrence or non-zero expected abundance or non-negligible expected densities. Statistical habitat models may also be used to estimate the absolute or relative distribution of **mature individuals**.

Statistical habitat models generally require a large number of sampling points (presence only, presence/absence, or abundance). Given adequate data, statistical analysis can account for variation in sampling effort and detectability.

Validation

The final **ESH** map should include all known, inferred or projected occurrences (including conservation translocations but excluding vagrancies), and all habitat (with unsuitable areas removed).

Habitat maps and models can vary widely in quality and accuracy. A map or model may not provide an accurate representation of habitat if key variables are omitted. For example, a map would overestimate the habitat of a forest-dependent montane species if it identified all forest areas as potential habitat, irrespective of altitude.

All habitat maps or models used in **KBA** assessments should therefore be subject to a critical evaluation based on biological and statistical considerations (where applicable). The selection of environmental covariates should be based on knowledge of the biology of the species and not simply fitted statistically from a pool of candidate variables that are conveniently available.

All habitat maps or models used in **KBA** assessments (including **ESH** maps) should be validated with independent occurrence data. See Dahal et al. (in press) for validation methods for deductive approaches. When using inductive approaches, appropriate methods for model selection and evaluation should be employed,

including statistical tests of goodness-of-fit (e.g., the area-under-the-curve, Akaike's Information Criterion).

Habitat maps and models that have not been published in the peer-reviewed literature should be sufficiently rigorous to pass peer review.

Documentation

In the documentation, [KBA Proposers](#) are requested to include sufficient information on datasets and mapping procedures to enable reproduction of the final [ESH](#) layer, and describe the process whereby the [ESH](#) map was created and validated (including the degree of expert engagement). The final [ESH](#) spatial data layer should also be submitted to the [KBA Secretariat](#) for archiving. This file may then be provided to other [KBA Proposers](#) for use in future [KBA](#) proposals (with a reference to the original spatial data source).

III.3 Estimating area of occupancy (AOO)

The area within the [range](#) of a species that is actually occupied (IUCN, 2012a). [AOO](#) is the area of habitat that is occupied by the species, based on known, inferred and projected occurrences (IUCN, 2001).

Existing data on AOO

For some species that have been assessed for the [IUCN Red List](#), [AOO](#) may have been defined and mapped already. [AOO](#) maps must be validated before they can be used in [KBA](#) identification. Validated [AOO](#) maps can be obtained from the [KBA Secretariat](#), if available.

Estimating AOO

If there is no validated [AOO](#) map or the [AOO](#) map needs updating, [KBA Proposers](#) seeking to use [AOO](#) as an assessment parameter should see the [IUCN Red List Mapping Standards](#) for detailed guidelines on mapping [AOO](#).

Habitat maps and models cannot be used to estimate a species' [AOO](#) directly because they map areas of habitat that may presently be unoccupied (i.e. outputs are closer to [ESH](#) than [AOO](#)). Low habitat-occupancy may result because factors other than habitat are limiting, such as exploitation, availability of prey, impacts of predators, competitors or disturbance, dispersal limitations. Habitat maps and models may therefore need to be filtered to produce a valid depiction of [AOO](#) for use in [KBA](#) identification. In some cases, filtering out areas that are unlikely to be occupied may

be fairly straight-forward. For example, projected occurrences in habitat patches that are small and distant from habitat patches with known [localities](#) may be filtered out using knowledge of the species' dispersal limitations; projected occurrences in areas close to roads or human population centres may be filtered out if hunting is a threat; areas that lack recent known occurrences and are known to have been affected by pathogens may be filtered out.

[AOO](#) must be assessed based on a grid. The [IUCN Red List Guidelines](#) (IUCN SPC, 2022, Section 4.10.7) provide the following three conditions for using habitat maps or models to estimate [AOO](#):

- i) Habitat maps and models must be justified in the documentation as accurate representations of the habitat requirements of the species and validated by a means that is independent of the data used to construct them.
- ii) The area of *potential* habitat must be filtered to produce an estimate of the area of *occupied* habitat.
- iii) The estimated area of occupied habitat derived from the map must be scaled to the reference scale of 2 x 2 km. (A standardised 2 x 2 km grid is provided on the [KBA website](#) (Tools page).)

These conditions generally require adequate sampling intensity to be confident that the absence of records in cells represents a genuine absence of the species. Unfortunately, this information is lacking for most species.

Validation

The final [AOO](#) map should include all known, inferred or projected occurrences (including conservation translocations but excluding vagrancies).

[AOO](#) maps must be validated with independent occurrence data (IUCN SPC, 2022, Section 4.10.7). See the section on Validation in Appendix III.2 above for additional requirements for habitat maps and models used in [KBA](#) assessments.

Documentation

In the documentation, [KBA Proposers](#) are requested to include sufficient information on datasets and mapping procedures to enable reproduction of the final [AOO](#) map, and describe the process whereby the [AOO](#) map was created and validated (including the degree of expert engagement). The final [AOO](#) spatial data layer should also be submitted to the [KBA Secretariat](#) for archiving. This file may then be provided to other [KBA Proposers](#) for use in future [KBA](#) proposals (with a reference to the original spatial data source).

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Appendix IV: Mapping ecosystem extent

Spatial data showing the **extent** of **biogeographic ecotypes** (Level 4) will be made available through the **Red List of Ecosystems (RLE)** website once mapping is complete. For **global ecosystem types** (Level 5), **KBA Proposers** should use the following guidelines on estimating the extent of an **ecosystem type** (i.e. geographic distribution), extracted from the **RLE Guidelines** (Bland et al., 2017, p. 46 ff).

Remote sensing is a common approach for mapping the geographic distributions of many terrestrial and marine ecosystems. Global data sets, such as those available for forests (Hansen et al., 2013), mangroves (Giri et al., 2011), water cover (Pekel et al., 2016), and coral reefs (Andréfouët et al., 2006), may provide a useful basis for superimposing appropriate classifications of **ecosystem types**. Spatial proxies for ecosystem distributions (such as climate, substrate, topography, bathymetry, ocean currents, flood regimes, water cover, aquifers or some synthesis of these that can be justified in the documentation as valid representations of the distribution of ecosystem biota or its niche space) may be used in some cases. Physical factors such as sea floor characteristics, ocean currents, water temperatures and water chemistry may be appropriate predictors of ecosystem distribution for marine ecosystems.

Spatial distribution models offer an additional opportunity to formally select and combine the most suitable set of spatial proxies to predict ecosystem distributions. Clark et al. (2015), for example, used bathymetric spatial data and remote sensing data on sea ice concentration to model the distribution of suitable light conditions for under-ice marine benthic invertebrate communities in Antarctic waters. When using spatial proxies or developing spatial distribution models, a mechanistic understanding of the relationship between occurrence of the ecosystem and limiting environmental factors is essential for developing a valid representation of the geographic distribution of an **ecosystem type**. Spatial distribution models should follow best practice recommendations for each model type and should be validated (see IUCN SPC, 2022, Section 4.10.7).

Once the geographic distribution of an **ecosystem type** has been assessed using the methods described above, areas that have been lost to settlement, agriculture or other forms of habitat conversion should be removed before calculating the **global** and **site-level extent** of the **ecosystem type**.

The spatial resolution (e.g., pixel size) of an ecosystem map should be as fine as practical, consistent with the input data and the scale of the ecosystem (e.g., Fig.

AIV.1). Ecosystem maps will typically be at a much finer resolution than the standard 10 x 10 km grid used for estimating the area occupied by an ecosystem (see Bland et al., 2017, p. 57.)

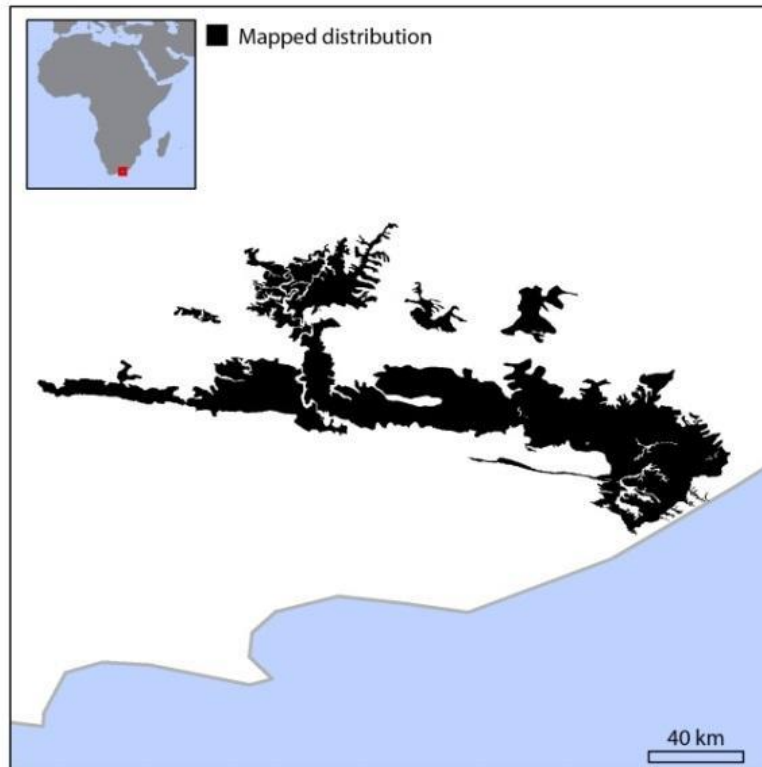


Figure AIV.1. The geographic distribution of the Great Fish Thicket, South Africa (Mucina & Rutherford, 2006) is depicted by a raster dataset with a spatial resolution of 30 x 30 m (shown in black). As mapped, the extent of the Great Fish Thicket ecosystem type is 6,763.4 km². Source: Bland et al., 2017, Box 10.

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Appendix V: Ecoregion and bioregion templates

V.1 Ecoregion templates

The **ecoregion** templates used to generate lists of **ecoregion**-restricted species for Criterion B3a (Section 2.7) and as the unit of analysis for Criterion C (Section 5) are documented here.

Terrestrial ecoregions

The terrestrial **ecoregion** template (Fig. AV.1.1) was taken from Dinerstein et al. (2017), updating the terrestrial **ecoregion** template previously published by Olson et al. (2001).

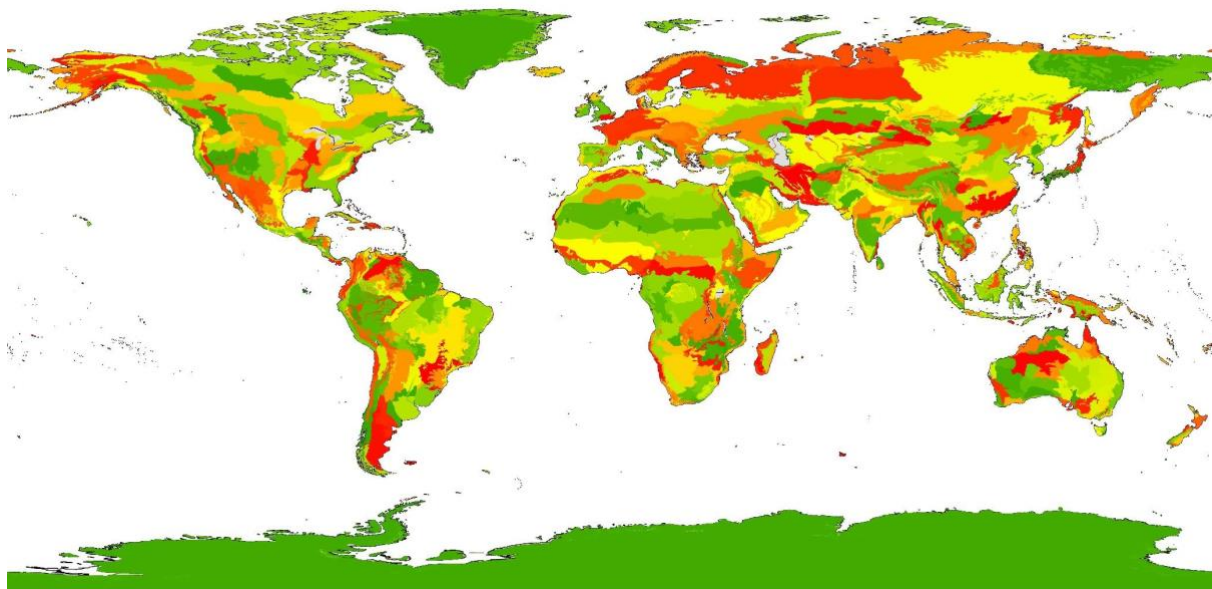


Figure AV.1.1. Terrestrial ecoregions. *Source: Dinerstein et al., 2017.*

Freshwater ecoregions

The freshwater ecoregion template (Fig. AV.1.2) is taken from Abell et al. (2008).

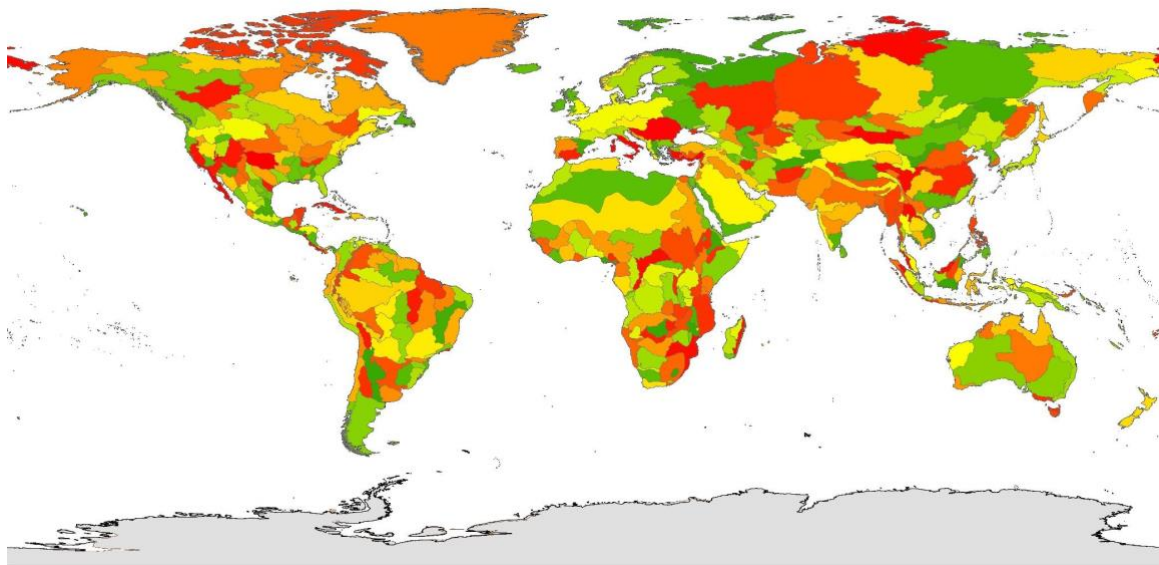


Figure AV.1.2. Freshwater ecoregions. *Source: Abell et al., 2008.*

Marine ecoregions

The marine ecoregion template (Fig. AV.1.3) is taken from Spalding et al. (2007), and pelagic provinces by Spalding et al. (2012). These were combined into a single map by TNC (2012). The marine ecoregions component of this combined map were used as ecoregion boundaries for the purposes of KBA identification (Fig. AV.1.3). Ecoregions have not yet been defined for the high seas.

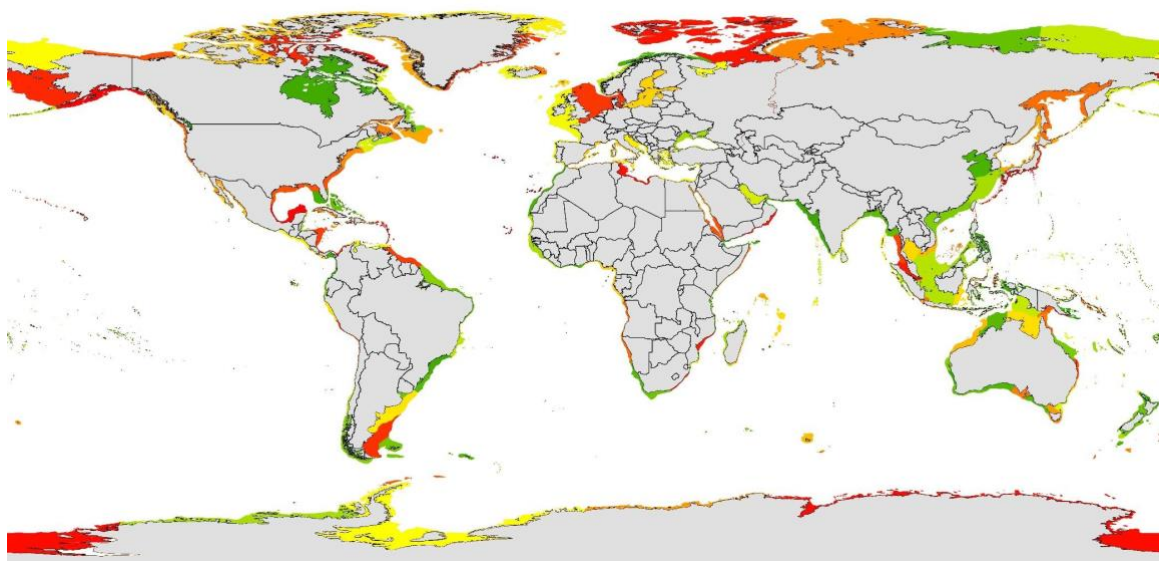


Figure AV.1.3. Marine ecoregions. *Source: TNC, 2012; based on Spalding et al., 2007, 2012.*

V.2 Bioregion templates

Bioregion templates for terrestrial, freshwater and marine systems are currently being evaluated and will be provided in due course.

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Appendix VI: Decision support tools for complementarity-based quantitative analysis of irreplaceability

The recommended decision support tools for conducting [complementarity](#)-based quantitative analysis of [irreplaceability](#) under Criterion E are [Marxan](#) (Ball et al., 2009), Conservation Land-Use Zoning software ([CLUZ](#); Smith, 2019) or [prioritizr](#) using the replacement-cost function (Hanson et al., 2017).

[Irreplaceability](#) can be measured using various metrics. Pressey et al. (1994) proposed a method that was computed as the number of representative combinations including the focal spatial unit divided by the total number of representative combinations, but this is computationally costly and cannot be calculated for large numbers of spatial units. Ferrier et al. (2000) proposed two methods, including summed [irreplaceability](#), but this can exceed a value of 1 and is not easily rescaled, which makes it difficult to use in Criterion E assessments.

The software [Marxan](#) (Ball et al., 2009) approximates [irreplaceability](#) by running an algorithm with the objective function of minimising the total network area or cost, subject to the constraint of achieving the representation [targets](#). The algorithm is run a large number of times and the [irreplaceability](#) of each spatial unit is approximated by its selection frequency. This is the most widely used approach for estimating [irreplaceability](#). However, it is based on a large number of suboptimal solutions — it can approximate [irreplaceability](#) if [Marxan](#) can find near-optimal solutions, but selection frequencies across spatial units will then tend to 0 or 1.

[CLUZ](#) (Smith, 2019) is a user-friendly GIS plug-in that links to [Marxan](#).

With integer linear programming methods now available in tools such as [prioritizr](#) (Hanson et al., 2017), it is possible to calculate the optimal solution for a given conservation planning problem. Given a single optimal solution, the selection frequency for each spatial unit will be 0 or 1. [prioritizr](#) provides two alternative methods for estimating [irreplaceability](#) — the replacement cost method (Cabeza & Moilanen, 2006) is recommended for Criterion E analysis.

[KBA Proposers](#) are advised to review software manuals carefully to check for relevant practical limitations (e.g., the maximum number of planning units that can be

included and expected run times), recognising that software and computing power are improving all the time (see Schuster et al., 2019 for example).

Baisero et al. (2021) developed a proximity-to-irreplaceability metric (proxirr) that separates measurement of **irreplaceability** from **complementarity**. This is not currently recommended for use in Criterion E assessments because the **KBA Standard** specifies that **complementarity**-based methods should be used.

Given the various ways that **irreplaceability** can be estimated, **KBA Proposers** should clearly document the method used to enable proper review.

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Appendix VII: Use of equivalent systems as proxies for IUCN Red List assessments

The **IUCN Red List** is the global standard for species threat assessments despite its taxonomic and geographic gaps (Stuart et al. 2010) and using it as the authority for **threatened** species increases the rigour and transparency of the **KBA** identification process. Species that can trigger **KBA** Criterion A1 are:

- species assessed as **globally threatened** (i.e. CR, EN or VU) on the **IUCN Red List**; and
- species that (a) have not been assessed **globally** and (b) are **endemic** to the region/country in question and (c) have been assessed as regionally/nationally **threatened** following the **Guidelines for Application of IUCN Red List Criteria at Regional and National Levels** (IUCN, 2012b) or **equivalent systems**.

What are equivalent systems?

Equivalent systems refers to regional- or national-based assessment processes that produce **global** status assessments that: i) are based on similar criteria to the **IUCN Red List** and can be reliably cross-walked to the **IUCN Red List**; ii) set similar standards for minimum supporting documentation and involve an appropriate process of independent review; and iii) are implemented by recognised assessment bodies in the region/country in question (e.g., NatureServe in the USA/Canada, the Threatened Species Scientific Committee in Australia), based on science and input from scientists/experts throughout the entirety of each species' **range**.

By definition, **equivalent systems** have demonstrated consistency with **IUCN Red List** assessments and so can serve as reliable proxies. There are **taxonomic groups** with large numbers of species that have not yet been assessed for the **IUCN Red List** that have been assessed as **globally threatened** under **equivalent systems**. Allowing such species to trigger **KBAs** under Criterion A1 expands the scope of Criterion A1 to include **taxonomic groups** that have not yet been assessed for the **IUCN Red List**, in a way that is consistent with the **IUCN Red List** and hence with the intent of the **KBA Standard**.

What if there is a mismatch in taxonomy?

Each species in the **WDKBA** must have a unique identification number, unique scientific name, and a single status assessment, as per the database that underpins the

IUCN Red List (i.e. the Species Information Service, SIS). This is essential for the functionality of the **WDKBA**.

In the case of a mismatch in taxonomy, the species concept used for **KBA** identification must be consistent with the species concept used in the SIS. In the case of a simple difference in nomenclature for the same species concept (e.g., *Morus capensis* in SIS; *Sula capensis* in the equivalent system), the difference in nomenclature should not impede **KBA** assessment. On the other hand, where there is a difference in treatment of a species or species complex (e.g., *Canis lupus lycaon* is recognised as a subspecies of *C. lupus* on the **IUCN Red List**, but as a distinct species in some other systems), a **KBA** may only be triggered by a full species recognised by the **IUCN SSC Red List Authority** or **IUCN Red List Unit** (see Section 2.2.1). (See also Section 2.2.1 for detailed guidelines on the process for updating taxonomy in the case of new information.)

What if there is already a global IUCN Red List assessment?

Equivalent systems may only be used for species that do not have a **global IUCN Red List** assessment.²⁶

If the **global IUCN Red List** assessment is flagged as “needs updating”, it is strongly recommended that all efforts are made to update the **IUCN Red List** assessment prior to **KBA** identification. The **KBA Proposer** should request that the national/regional assessment body prepare an updated **IUCN Red List** account and submit it to the relevant **IUCN SSC Red List Authority**. In addition, the **KBA Proposer** may ask the their **KBA RFP** to request that the **IUCN SSC Red List Authority** update the assessment for the species.

If the national/regional assessment body provides the required information, but the **IUCN SSC Red List Authority** does not submit an updated assessment for publication on the **IUCN Red List** within a reasonable timeframe, the **KBA Proposer** may request the **KBA Secretariat** (through their **KBA RFP**) to allow that the equivalent system assessment be used in the interim for species that are endemic to the region or country where the equivalent system is recognised. The **KBA Secretariat** will then consult with the **IUCN SSC Red List Authority** or **IUCN Red List Unit** to check that the equivalent system assessment corresponds to the expected updated **IUCN Red List** assessment

²⁶ Note. A species listed as "Not Evaluated (NE)" has not yet been assessed against the IUCN Red List Categories and Criteria. This does not qualify as having an IUCN Red List assessment for the purposes of this appendix. A species listed as "Data Deficient (DD)" does not have adequate data to assess its extinction risk using the IUCN Red List Categories and Criteria. This qualifies as having an IUCN Red List assessment for the purposes of this appendix.

(in particular, the delay should not reflect a significant disagreement about the species' status). Decisions will be made on a species-by-species basis. (Please note that this option may no longer be available once the [WDKBA](#) is fully linked to the SIS. This appendix will then be updated accordingly.)

What about non-endemic species?

Regional- or national-based [equivalent systems](#) cannot be used for species that are not endemic to the region or country where the equivalent system is the recognised assessment body (e.g., USA/Canada for NatureServe's G-ranks, Australia for species listed under Australia's Environment Protection and Biodiversity Conservation Act). Given that each species can only have a single [global](#) status in the [WDKBA](#), this stipulation minimises the potential for conflict over status assessments (for example, because the assessor is not recognised as the relevant assessment body in some part of a species' [range](#) and/or different assessments are made for the same species by different regional/national authorities).

For non-endemic species that have been identified as [globally threatened](#) by equivalent systems, the best solution is for the [KBA Proposer](#) to request that the national/regional assessment body prepare an [IUCN Red List](#) account and submit it to the relevant [IUCN SSC Red List Authority](#). In addition, the [KBA Proposer](#) may ask their [KBA RFP](#) to request that the [IUCN SSC Red List Authority](#) prioritise assessment of the species.

Where does the responsibility lie for determining whether a system meets the criteria for use as an equivalent system?

The [KBA Standards and Appeals Committee](#) has the responsibility for verifying that criteria (i) and (ii) above are met, i.e. that the criteria are similar and there is a reliable cross-walk and that documentation standards and review are appropriate. [KBANCGs](#) are responsible for determining whether (iii) is met, i.e. whether the assessment agency is the recognised authority in the region/country, and whether assessments are based on science and input from scientists/experts throughout the species' [range](#).

Are NatureServe's G-ranks considered an equivalent system?

Yes, NatureServe's G-ranks are considered an equivalent system, as the system complies with the three criteria established above. Specifically, species that (a) have not been assessed [globally](#) for the [IUCN Red List](#) and (b) are [endemic](#) to the USA/Canada and (c) have been assessed as possibly extinct (GH), possibly extinct in the wild (GHC), critically imperiled (G1) or imperiled (G2) can trigger [KBA](#) Criterion

A1. For the purposes of [KBA](#) identification, species listed as GH, GHC or G1 are considered equivalent in status to species listed as CR or EN on the [IUCN Red List](#); whereas species listed as G2 are considered approximately equivalent in status to species listed as VU on the [IUCN Red List](#) (Master et al. 2012). Rounded NatureServe G-ranks should be used when a species has been assigned a range rank (e.g., G1G3 is rounded to G2). Species assessed over 8-12 years ago should be reassessed prior to being used to identify [KBAs](#).

References

Master, L.L., Faber-Langendoen, D., Bittman, R., Hammerson, G.A., Heidel, B., Ramsay, L., Snow, K., Teucher, A. and Tomaino, A. (2012). *NatureServe Conservation Status Assessments: Factors for Evaluating Species and Ecosystem Risk*, Arlington, VA: NatureServe.

Appendix VIII: Examples of expert statements on reproductive units

Statements in the following form provide the information necessary to validate that the **reproductive-units threshold** has been met. Each of these statements includes the following:

- a) confirmation that the species has recently been observed at the **site** with an approximate date (e.g., year);
- b) information indicating that the species has been reliably identified;
- c) a brief description of how a **reproductive unit** is defined for the species;
- d) some form of documentation (e.g., a journal article, report, letter or email);
- e) contact details for the biodiversity knowledge-holder(s) who made the observation or verified the species identification. (Contact details will not be published.)

“A 2015 site survey led by Prof. Q of the Dept of Botany of National University reports at least 5 mature individuals of this monoecious plant species based on field observations [survey report is available here].”

“The 2018 site monitoring report [available here] states that 5 distinct packs were resident at the site in 2018 based on repeated field observations. Each pack represents a reproductive unit as the alpha male and female in a pack are the parents of most surviving pups. The species is unmistakable.”

“A photograph showing approximately 100 mature individuals (at least 10 males and 10 females) taken at the site in 2014 was verified to species by A. N. Expert.” [image attached; contact details provided but not published]

“The 2016 IUCN Red List account supplementary information (Table 2) indicates that at least 20 nests were recorded in each of the 5 years 2010-2015. A. N. Expert confirms that, on average, each mature female using the beach makes 3 nests in a breeding season and no other species of marine turtles uses the site for breeding.” [complete reference provided; contact details provided but not published]

“The species was listed as Least Concern on the IUCN Red List in 2019. The Population section of the IUCN Red List account states that the species is common throughout its range. The site encompasses more than 20% of known localities. A. N. Expert confirms that 10 mature females and at least 1 mature

male would qualify as 10 reproductive units.” [complete reference provided; contact details provided but not published]

Statements in the following form are also acceptable, even though they lack supporting documentation:

“Mature males are easily identified to species by their scarlet crest. At least 10 breeding pairs were observed at the site by A Person in 2015.” [contact details provided but not published]

“Biodiversity knowledge-holders of the YY tribe state that they have observed the species regularly at the site over the last decade (2007-2017) including many females with young (at least 10 females with young in each year).” [contact details provided but not published]

“The presence of at least 5 reproductive units at the site is inferred from observation of abundant tadpoles in 5 spatially distant ponds during a site visit by A N Expert in 2016.” [contact details provided but not published]

“A N Expert infers the ongoing presence of at least 10 reproductive units based on repeated observations of occupied nests over the last decade (2009-2019).” [contact details provided but not published]

In contrast, the following statements require clarification or additional information before it can be confirmed that the reproductive-units threshold has been met:

“At least 30 breeding pairs were observed at the type locality by A N Expert in 2010.” [contact details provided but not published] (This text does not indicate whether the type locality falls within the site. Clarification that the locality where the species was observed falls within the site is required.)

“The species is abundant where found.” (This text does not indicate whether the species has been observed at the site. Clarification that the species has recently been observed at the site is required, especially if range, ESH, or AOO was used as the assessment parameter.)

“The site is one of only five known localities.” (This text provides no information on when the species was last observed at the site, let alone in numbers that meet the reproductive-units threshold.)

“A N Expert (2013) says that the species is common in XX Lake.” [contact details provided but not published] (This text does not indicate whether XX

Lake lies within the site. If not, there is no information that the species has been observed at the site.)

“The IUCN Red List account (2019) indicates that the species is common in suitable habitat.” (This provides no information on whether the species has been observed at the site.)

“A N Expert (or experts at the 2014 IUCN Red List workshop) believe(s) there are more than 10 reproductive units at the site.” [contact details provided but not published] (This text provides no information about the information the expert(s) used to make this inference or the approximate date of the information used.)

“Anecdotal information indicates that there may be over 50 reproductive units at the site.” (This text provides no way to evaluate the information – there is no named expert (or group of experts), no date, no basis for the inference.)

Appendix IX: Links to related documents and web resources

A Global Standard for the Identification of Key Biodiversity Areas, Version 1.0:

<https://portals.iucn.org/library/sites/library/files/documents/2016-048.pdf>

KBA online training course:

<https://www.conservationtraining.org/course/view.php?id=1145>

IX.1 Documents and resources available on the KBA website

AOO 2 x 2 km grid: www.keybiodiversityareas.org/working-with-kbas/proposing-updating/criteria-tools

Bioregion shapefiles [in preparation]

Bioregion-restricted species [in preparation]

Ecoregion shapefiles [in preparation]

Ecoregion-restricted species [in preparation]

Guidelines on Business and KBAs: www.keybiodiversityareas.org/about-kbas/applications/private-sector

KBA Appeals procedure: <https://www.keybiodiversityareas.org/working-with-kbas/proposing-updating/appeals>

KBA Partners: <https://www.keybiodiversityareas.org/working-with-kbas/programme/partnership>

KBA proposal form: <https://www.keybiodiversityareas.org/working-with-kbas/proposing-updating/proposal-process>

KBA Proposal Process guidance: <https://www.keybiodiversityareas.org/working-with-kbas/proposing-updating/proposal-process>

KBA Proposer: <https://www.keybiodiversityareas.org/working-with-kbas/proposing-updating/proposal-process>

KBA Regional Focal Points: <https://www.keybiodiversityareas.org/working-with-kbas/programme/regional-focal-points>

KBA National Coordination Groups:

<https://www.keybiodiversityareas.org/working-with-kbas/programme/national-coordination-groups>

KBA Secretariat: <https://www.keybiodiversityareas.org/working-with-kbas/programme/secretariat>

KBA Standards and Appeals Committee:

<https://www.keybiodiversityareas.org/working-with-kbas/programme/standards-and-appeals-committee>

KBA Technical Working Group: <https://www.keybiodiversityareas.org/working-with-kbas/programme/technical-working-group>

KBA training materials: www.keybiodiversityareas.org/working-with-kbas/proposing-updating/training

KBA website: www.keybiodiversityareas.org/

KBAs and protected areas: <http://www.keybiodiversityareas.org/about-kbas/applications>

Restricted-range species: <http://www.keybiodiversityareas.org/working-with-kbas/proposing-updating/criteria-tools>

Taxonomic groups for applying Criteria B2 and B3:

<http://www.keybiodiversityareas.org/working-with-kbas/proposing-updating/criteria-tools>

World Database of Key Biodiversity Areas (WDKBA):

<http://www.keybiodiversityareas.org/kba-data>

IX.2 External documents and resources

Alliance for Zero Extinction (AZE): <https://zeroextinction.org/>

Catalogue of Life: <http://www.catalogueoflife.org/>

Conservation Land-Use Zoning software (CLUZ):

<https://anotherbobsmith.wordpress.com/software/cluz/>

Convention on Biological Diversity (CBD): <https://www.cbd.int/>

Dryad Digital Repository: <https://datadryad.org/>

EICAT Guidelines:

https://www.iucn.org/sites/dev/files/content/documents/eicat_guidelines_v1.1.pdf

FishBase: <https://www.fishbase.se/search.php>

Free, Prior and Informed Consent (FPIC):

<http://www.forestpeoples.org/sites/fpp/files/publication/2010/08/fpicsynthesisjun07eng.pdf>

GenBank: <https://www.ncbi.nlm.nih.gov/genbank/>

Global Biodiversity Information Facility (GBIF): <https://www.gbif.org/>

Global consultation process to develop the KBA Standard:

<https://www.iucn.org/commissions/world-commission-protected-areas/our-work/biodiversity-and-protected-areas/key-biodiversity-areas>

Global Seabird Tracking Database: <http://www.seabirdtracking.org/>

GlobalTreeSearch: https://tools.bgci.org/global_tree_search.php

Google Earth: <https://www.google.com/earth/>

Guidelines for the application of IUCN Red List of Ecosystems Categories and Criteria: see RLE Guidelines

Guidelines for using the IUCN Environmental Impact Classification for Alien Taxa (EICAT) Categories and Criteria: see EICAT Guidelines

HydroBASINS: <http://hydrosheds.org/page/hydrobasins>

Indigenous and Community Conserved Areas (ICCAs):

<https://www.iccaconsortium.org/>

Intact Forest Landscapes: <http://www.intactforests.org/>

Integrated Biodiversity Assessment Tool: <https://www.ibat-alliance.org/>

Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services Approach to recognizing and working with indigenous and local knowledge:

https://ipbes.net/sites/default/files/inline/files/ipbes_ilkapproach_ipbes-5-15.pdf

IUCN Global Ecosystem Typology: <https://portals.iucn.org/library/node/49250>

IUCN Green List of Protected and Conserved Areas:

<https://www.iucn.org/theme/protected-areas/our-work/iucn-green-list-protected-and-conserved-areas>

IUCN Policy On Conservation and Human Rights for Sustainable Development:
<https://www.ohchr.org/Documents/Issues/Environment/ImplementationReport/IUCN2.pdf>

IUCN Red List Guidelines: <https://www.iucnredlist.org/resources/redlistguidelines>

IUCN Red List Habitat Classification Scheme:
<https://www.iucnredlist.org/resources/habitat-classification-scheme>

IUCN Red List of Threatened Species: www.iucnredlist.org

IUCN Red List Mapping Standards:
<https://www.iucnredlist.org/resources/mappingstandards>

IUCN Red List Unit: redlist@iucn.org

IUCN SSC Conservation Genetics Specialist Group:
<https://www.iucn.org/commissions/ssc-groups/disciplinary-groups/conservation-genetics>

IUCN SSC Red List Authorities: <https://www.iucnredlist.org/assessment/authorities>

IUCN SSC Specialist Groups: <https://www.iucn.org/commissions/ssc-groups>

IUCN Standard on Indigenous Peoples:
https://www.iucn.org/sites/dev/files/iucn_esms_standard_indigenous_peoples-2.1.pdf

Marxan: <https://marxansolutions.org/>

NatureServe Explorer: <https://explorer.natureserve.org/>

NatureServe's National Species Dataset (for the US and Canada):
<http://www.natureserve.org/conservation-tools/national-species-dataset>

Ocean Biogeographic Information System (OBIS): <http://www.iobis.org/>

Plantlife Important Plant Areas (IPA) Database: <http://www.plantlifeipa.org/home>
prioritizr: <https://prioritizr.net/>

Protected Planet Database: <https://www.protectedplanet.net/>

Ramsar Sites Information Service: <https://rsis.ramsar.org/>

Red List of Ecosystems (RLE): <https://iucnrle.org/>

RLE Committee on Scientific Standards: <https://iucnrle.org/>

RLE database: <https://iucnrle.org/>

RLE Guidelines: <https://portals.iucn.org/library/node/45794>

SeaLifeBase: <https://www.sealifebase.ca/>

Sensitive Data Access Restrictions Policy for the IUCN Red List:

[https://cmsdocs.s3.amazonaws.com/keydocuments/Sensitive Data Access Restrictions Policy for the IUCN Red List.pdf](https://cmsdocs.s3.amazonaws.com/keydocuments/Sensitive_Data_Access_Restrictions_Policy_for_the_IUCN_Red_List.pdf)

Sequence Read Archive: <https://www.ncbi.nlm.nih.gov/sra>

World Register of Marine Species: <http://www.marinespecies.org/>

Appendix X: Summary of changes, clarifications and additions to the KBA Guidelines

Changes, clarifications and additions in Version 1.2 (July 2022)

Section 1.11: New section on KBA monitoring.

Section 2.2.1: Minor revisions to guidelines on taxonomy of species not yet included in the Species Information Service; clarification of rationale for focusing on species, rather than subspecies or varieties.

Section 2.2.2: New question on whether species without range maps can trigger a KBA.

Section 2.2.3: Clarification that Criteria A1 and B1-3 are not generally applicable to stop-over or bottleneck sites.

Section 2.4.2: Clarification that KBA subcriteria A1 c and d can be applied to species listed under IUCN Red List Criterion A plus E; clarification of the level of confidence required for identifying a KBA under subcriterion A1e.

Section 2.4.3: Clarification that number of mature individuals should not be used as an assessment parameter for species listed as CR (PE) or CR (PEW).

Section 2.6.1: Explanation of how the standard taxonomic groups for applying Criteria B2 and B3 were identified.

Section 2.8.2: Clarification that a species can trigger subcriterion D1b if it is only known to aggregate at 10 or fewer localities.

Section 3.1: Clarification of the concept of significant fluctuations in population size; new question on whether the proportion of the global population size at a site can be rounded up.

Section 3.2: New note that the recommendation in the IUCN Red List Categories and Criteria to use a lower population size estimate for species with fluctuating population size is not appropriate in the context of KBA assessment.

Section 3.4: Clarification of standard projection for use in GIS.

Section 3.6: Clarification that ESH can be based on deductive approaches (e.g., area of habitat, AOH) or inductive approaches (i.e. statistical habitat models).

Section 3.7: Revisions to guidelines on using AOO for species with fine-scale distribution patterns.

Section 3.8: New guideline on using number of localities as an assessment parameter where there are clusters of occurrences on a site boundary.

Section 4.2: New question on whether collapsed ecosystem types can trigger a KBA.

Section 4.3.3: New question on whether the proportion of the global ecosystem extent at a site can be rounded up

Section 5: Major revisions to guidelines on identifying KBAs based on ecological integrity.

Section 6: Revisions to the recommended workflow for identifying KBAs based on quantitative analysis of irreplaceability; new guidance on targets for non-endemic species and on documentation.

Section 7.3: New suggestion to include a buffer when delineating KBAs for freshwater biodiversity. New guidance on partitioning landscapes or seascapes into smaller manageable units.

Section 7.4: New section on documenting the delineation rationale and manageability.

Section 8.2: Clarifications on requirements and recommendations for consensus-building with proposers of existing KBAs; clarification of documentation of overlap between proposed KBAs and Indigenous territories or areas subject to customary tenure.

Section 9.2.3: Revisions to guidelines on evidence for reproductive units and age of data used to confirm presence or reproductive units.

Section 10: Numerous edits including an additional reason for a change in KBA status and new guidelines on reassessment of sites qualifying as KBAs under Criterion C or E.

Appendix I: Clarification that the definition of AOO does not include old or vagrant occurrences.

Appendix III: Restructured: the note on habitat maps and models (formerly Appendix III.4) has been merged into section on ESH (Appendix III.2).

Appendix VIII: New appendix with examples of expert statements on reproductive units.

Changes, clarifications and additions in Version 1.1 (October 2020)

Section 1.9: New section on the role of local and national constituencies in KBA identification and delineation.

Section 2: Restructured to reduce duplication.

Section 2.1: New question on maximum number of sites per species.

Section 2.2: Updates to section on taxonomy. New question on re-introduced populations.

Section 2.3: New section on scoping analysis for species-based criteria.

Section 2.4: New recommendation that species with IUCN Red List assessments flagged as “Needs Updating” are reassessed prior to KBA identification. Clarification of when subcriteria A1c and A2d are applicable.

Sections 2.6 and 2.7: A list of standard taxonomic groups for applying Criteria B2 and B3 is now provided.

Section 2.7: Numerous edits, including new guidelines on applying subcriterion B3c.

Section 2.8: Numerous edits to clarify that a species must aggregate at the site to trigger Criterion D1. Clarification that subcriterion D1b can only be applied if it is not possible to apply subcriterion D1a. New question on interpretation of “over a season” in D1a.

Section 3.1: Expanded guidance on selecting assessment parameters.

Section 3.2: Clarification on how to ensure consistency with IUCN Red List estimates of global population size, and how to handle estimates based on proxies for mature individuals.

Section 3.3: Clarification that it is only necessary to report whether a species’ population meets the reproductive-units threshold is met, not provide a complete count

Section 3.4: Clarification that area-based parameters are not appropriate for species on migration; and new guideline on how to calculate area from range, ESH or AOO.

Section 3.5: Clarification on how to how to ensure consistency with IUCN Red List range maps.

Section 3.9: New section on relative density or abundance of mature individuals (Criterion B3).

Section 3.10: New section on distinct genetic diversity (Criterion A1, B1-2).

Section 4: Numerous edits to align with the recently published IUCN Global Ecosystem Typology.

Section 5.1: Additional guidance on identifying species indicative of ecological integrity, plus minor edits to strengthen links to the Red List of Ecosystems and Green List of Protected and Conserved Areas.

Section 6: New section on identifying Key Biodiversity Areas based on quantitative analysis of irreplaceability (Criterion E).

Section 7.3: Additional guidance on how to handle overlapping biodiversity elements.

Section 8.1: Additional guideline requiring Free Prior and Informed Consent (FPIC) prior to using any Indigenous name for a KBA.

Section 9.1: Updates to recommendations on handling sensitive data.

Section 9.2.3: Additional guidelines on confirmation of presence and reproductive units. (Section on confirming reproductive units has been moved here from Section 3.3.)

Section 9.3.2: Additional guidelines on how to handle fluctuating numbers of mature individuals at a site.

Section 10.2: Clarification of the reassessment period for IBAs and KBAs identified under previously published criteria.

Appendix I: Clarification of definitions of aggregation, bioregion, ecoregion; and ecosystem type consistent with the recently published IUCN Global Ecosystem Typology; new definitions of biological ecotype, ecological refugium, extent of an ecosystem type, equivalent system, global ecosystem type, recruitment source and vagrant.

Appendix II: Change to note on when subcriteria A1c and A2d are applicable.

Appendix III: Clarification on how to use coded areas in IUCN Red List range maps.

Appendix V: New appendix on ecoregion and bioregion templates.

Appendix VI: New appendix on decision support tools for complementarity-based quantitative analysis of irreplaceability.

Appendix VII: New appendix on the use of equivalent systems as proxies for IUCN Red List assessments.

Appendix IX: New appendix summarising changes to the KBA Guidelines.

Version 1.0 (January 2019)



**INTERNATIONAL UNION
FOR CONSERVATION OF NATURE**

WORLD HEADQUARTERS
Rue Mauverney 28
1196 Gland, Switzerland
mail@iucn.org
Tel: +41 22 999 0000
Fax: +41 22 999 0002
www.iucn.org
www.keybiodiversityareas.org
www.iucn.org/resources/publications