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

Version 1.1

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 1.1

IUCN is pleased to acknowledge the support of its Framework Partners who provide core funding: Ministry for Foreign Affairs of Finland; Government of France and the French Development Agency (AFD); the Ministry of Environment, Republic of Korea; the Norwegian Agency for Development Cooperation (Norad); the Swedish International Development Cooperation Agency (Sida); the Swiss Agency for Development and Cooperation (SDC) and the United States Department of State.

Published by: IUCN, Gland, Switzerland.

Citation: KBA Standards and Appeals Committee (2020). *Guidelines for using A Global Standard for the Identification of Key Biodiversity Areas*. Version 1.1. Prepared by the KBA Standards and Appeals Committee of the IUCN Species Survival Commission and IUCN World Commission on Protected Areas. Gland, Switzerland: IUCN. viii + 206 pp.

DOI: https://doi.org/10.2305/ IUCN.CH.2020.KBA.1.1.en

Cover photo: Hottentot sugarbush (*Protea lacticolor*), Western Cape, South Africa.
© Peter Thompson, some rights reserved. License: CC BY-NC

Available from: IUCN (International Union for Conservation of Nature)
Rue Mauverney 28
1196 Gland
Switzerland
Tel +41 22 999 0000
Fax +41 22 999 0002
chair.kba.sac@keybiodiversityareas.org
www.iucn.org/resources/publications

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

Contents

Acknowledgements vi
Abbreviations vii
Foreword 1
Purpose of the KBA Guidelines 1
How to use the KBA Guidelines 2
1. Introduction 3
1.1 Key Biodiversity Areas 3
1.2 A Global Standard for the Identification of Key Biodiversity Areas 3
1.3 Criteria and subcriteria for identifying Key Biodiversity Areas 4
1.4 Thresholds for identifying Key Biodiversity Areas 6
1.5 Confirmed presence of biodiversity elements in Key Biodiversity Areas 7
1.6 Climate and environmental change 8
1.7 Key Biodiversity Area boundaries 8
1.8 Stakeholder consultation and involvement 8
1.9 Locally and nationally driven process 9
1.10 Data availability, quality and uncertainty 10
1.11 Reassessment of sites as Key Biodiversity Areas 11
1.12 Definitions 11
1.13 Documentation 11
2. Identifying Key Biodiversity Areas using species-based criteria (A1, B1-3, D1-3) 12
2.1 Overview 12
2.2 Identifying species that are eligible to trigger KBAs 14
2.3 Scoping analysis for species-based criteria (A1, B1-3, D1-3) 18
2.4 Applying Criterion A1 to identify KBAs for threatened species 21
2.5 Applying Criterion B1 to identify KBAs for individual geographically restricted species 25
2.6 Applying Criterion B2 to identify KBAs for co-occurring geographically restricted species 27
2.7 Applying Criterion B3 to identify KBAs for geographically restricted assemblages 31
2.8 Applying Criterion D1 to identify KBAs for demographic aggregations 38
2.9 Applying Criterion D2 to identify KBAs for ecological refugia 44

2.10 Applying Criterion D3 to identify KBAs for recruitment sources ... 45
3. Assessment parameters for species-based criteria (A1, B1-3, D1-3 and E) ... 48
3.1 Selecting assessment parameters ... 48
3.2 Number of mature individuals (Criteria A1, B1-3, D1-3, E) ... 53
3.3 Reproductive units (Criteria A1, B1, B3, E) ... 58
3.4 Overview of area-based assessment parameters and localities (A1, B1-3, E) ... 61
3.5 Range (Criteria A1, B1-3, E) ... 63
3.6 Extent of suitable habitat (ESH, Criteria A1, B1-3) ... 66
3.7 Area of occupancy (AOO, Criteria A1, B1-3, E) ... 67
3.8 Number of localities (Criteria A1, B1-3) ... 69
3.9 Relative density or abundance of mature individuals (Criterion B3) ... 71
3.10 Distinct genetic diversity (Criteria A1, B1-2) ... 72
4. Identifying Key Biodiversity Areas using ecosystem-based criteria (A2, B4) ... 77
4.1 Overview ... 77
4.2 Scoping analysis for ecosystem-based criteria (A2, B4) ... 77
4.3 Applying Criterion A2 to identify KBAs for threatened ecosystem types ... 81
4.4 Applying Criterion B4 to identify KBAs for geographically restricted ecosystem types ... 84
5. Identifying Key Biodiversity Areas based on ecological integrity (Criterion C) ... 85
5.1 Defining ecological integrity ... 85
5.2 Applying Criterion C to identify KBAs with outstanding ecological integrity ... 86
6. Identifying Key Biodiversity Areas based on quantitative analysis of irreplaceability (Criterion E) ... 95
6.1 Overview ... 95
6.2 Scoping analysis for KBAs based on irreplaceability through quantitative analysis ... 98
6.3 Applying Criterion E to identify KBAs based on irreplaceability through quantitative analysis ... 108
7. Delineation procedures ... 110
7.1 Assembling spatial datasets ... 112
7.2 Deriving initial KBA boundaries based on ecological data ... 114
7.3 Refining ecological boundaries to yield practical KBA boundaries ... 115
8. Stakeholder consultation and involvement ... 128
8.1 Consultation with knowledge-holders ... 130
8.2 Consensus-building with proposers of existing KBAs ... 132
8.3 Involvement of customary rights-holders ... 133
8.4 Beyond KBA identification and delineation ... 134

9. Data availability, quality and uncertainty ... 136
9.1 Data availability ... 136
9.2 Data quality ... 138
9.3 Uncertainty ... 142
10. Reassessment ... 147
10.1 Reasons for a change in KBA status ... 147
10.2 Frequency of reassessment ... 148
10.3 Reassessment process ... 149
References ... 152
Index ... 160
Appendix I: Definitions of terms used in the KBA criteria ... 163
I.1 Terms used in defining KBAs ... 163
I.2 Terms used in the KBA criteria and delineation procedures ... 164
I.3 Additional terms ... 172
Appendix II: Summary of the KBA criteria and thresholds ... 178
Appendix III: Estimating range, extent of suitable habitat (ESH) and area of occupancy (AOO) ... 179
III.1 Range ... 179
III.2 Estimating extent of suitable habitat (ESH) ... 180
III.3 Estimating area of occupancy (AOO) ... 182
III.4 Note on habitat maps and models ... 183
Appendix IV: Mapping ecosystem extent ... 186
Appendix V: Ecoregion and bioregion templates ... 189
V.1 Ecoregion templates ... 189
V.2 Bioregion templates ... 191
Appendix VI: Decision support tools for complementarity-based quantitative analysis of irreplaceability ... 193
Appendix VII: Use of equivalent systems as proxies for IUCN Red List assessments ... 196
Appendix VIII: Links to related documents and web resources ... 200
VIII.1 Documents and resources available on the KBA website ... 200
VIII.2 External documents and resources ... 201
Appendix IX: Summary of changes, clarifications and additions to the KBA Guidelines ... 205

Acknowledgements

The *Guidelines for using a Global Standard for the Identification of Key Biodiversity Areas (Ver. 1.1)* were prepared by the Key Biodiversity Areas (KBA) Standards and Appeals Committee: Charlotte Boyd (Chair), Mike Bruford, Graham Edgar, Lincoln Fishpool, Vergilio Hermoso, Axel Hochkirch, Mike Hoffmann, John Lamoreux, Greg Mueller, Emily Nicholson, Eimear Nic Lughadha, Cristiano de Campos Nogueira, Ana Rodrigues, Carlo Rondinini, Lize von Staden, Stephen Woodley; with advice from the Technical Working Group of the KBA Committee: Olivia Crowe (BirdLife International; co-Chair), Penny Langhammer (Global Wildlife Conservation and Amphibian Survival Alliance; co-Chair), Thomas Brooks (IUCN), Graeme Buchanan (Royal Society for the Protection of Birds), Neil Cox (IUCN), Will Darwall (IUCN), Maria Dias (BirdLife International), Karl Didier (Rainforest Trust), Paul Donald (BirdLife International), Matthew Foster (Global Wildlife Conservation), Hedley Grantham (Wildlife Conservation Society), Justina Ray (Wildlife Conservation Society Canada), Christopher Tracey (NatureServe), Amy Upgren (American Bird Conservancy); and Andrew Plumptre (KBA Secretariat). The following additional experts also contributed to this or previous versions of the KBA Guidelines: Daniele Baisero, Fred Barasa, Stu Butchart, David Diaz, Moreno di Marco, Jonathan Handley, Kendall Jones, Stephen Kearney, Maria Lumbierres Civit, Golo Maurer, Rachel Neugarten, Ciara Raudsepp-Hearne, Ernst Retief, Catherine Sayer, Richard Schuster, Andrew Skowno, Bob Smith, Jenny Springer, Marcelo Tognelli, Marcos Valderrabano, Zoltan Waliczky, Lew Young. 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
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
NCG	National Coordination Group
RLE	Red List of Ecosystems
RFP	Regional Focal Point
SIS	Species Information Service
SSC	Species Survival Commission
VU	Vulnerable
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 VIII. 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 (and their associated assessment parameters), ecosystem-based criteria, and criteria based on ecological integrity, and quantitative analysis of irreplaceability. These 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 VIII 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			
A1 Threatened species	X	X	
A2 Threatened ecosystem types			X
B. Geographically restricted biodiversity			
B1. Individual geographically restricted species	X	X	
B2. Co-occurring geographically restricted species	X	X	
B3. Geographically restricted assemblages		X	
B4. Geographically restricted ecosystem types			X
C. Ecological integrity			
C. Ecological integrity		X	X
D. Biological processes			
D1. Demographic aggregations		X	
D2. Ecological refugia		X	
D3. Recruitment sources		X	
E. Irreplaceability through quantitative analysis			
E. Irreplaceability through quantitative analysis		X	

All sites should be assessed against as many KBA criteria and for as many taxonomic groups and ecosystem types as possible, given available data, but a site needs to meet the thresholds for only one criterion or subcriterion to qualify as a KBA. 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 a 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 ≥1% of the global population size and ≥10 reproductive units of a species listed as Vulnerable (VU) on the IUCN Red List (Fig. 1.3).

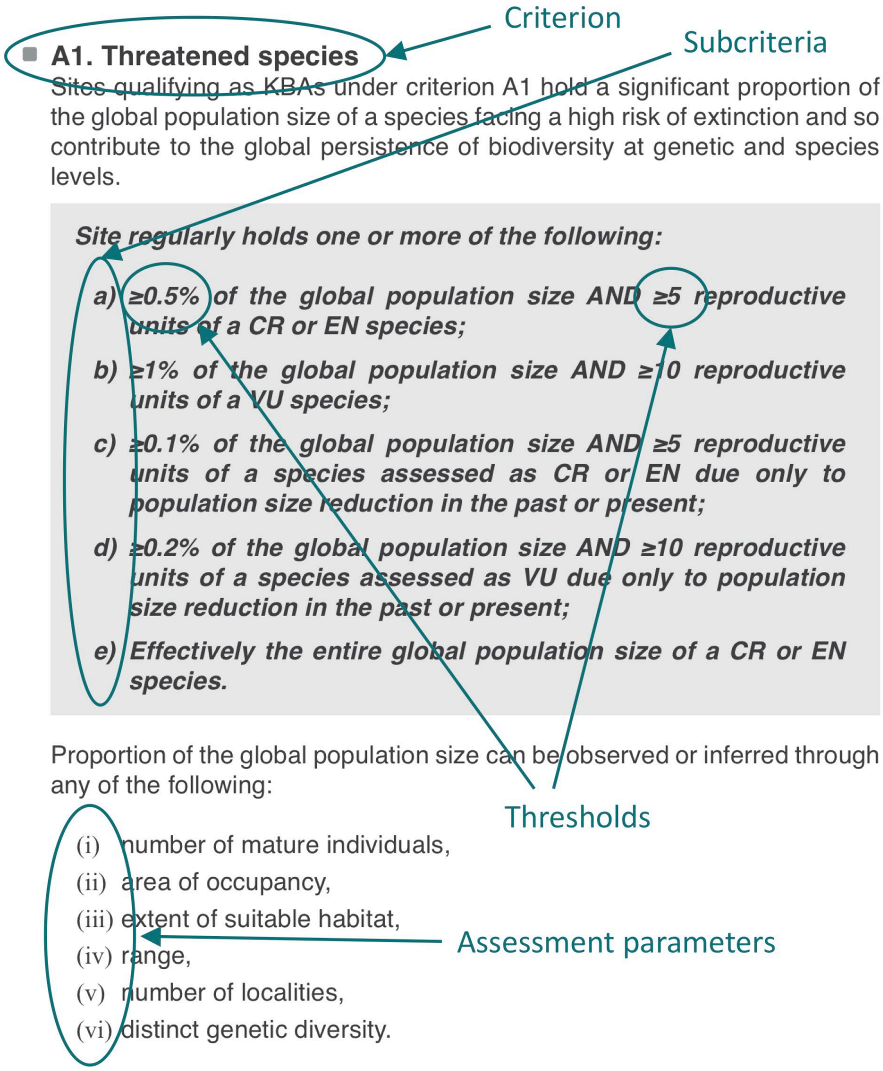

Figure 1.3 Criteria, subcriteria, thresholds and assessment parameters

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 ≥1% of the global population size of a Vulnerable species (Fig. 1.3), or under Criterion B4 if it holds 20% or more 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, number of localities and distinct genetic diversity.

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 verify that ecological communities at each proposed site are intact.

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. 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 KBA NCG, KBA Proposers should engage with their 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 coordinating the identification, mapping, and monitoring of KBAs, and facilitating stakeholder consultation and involvement in KBA identification and delineation. 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 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 assessing whether the data supporting a site's qualification as a KBA are reasonable and defensible. KBA proposals will be reviewed by independent reviewers during the submission process (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 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.

1.12 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 2019) and the Guidelines for the application of IUCN Red List of Ecosystems Categories and Criteria (IUCN 2017), which provide more detailed discussion of these parameters.

1.13 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.

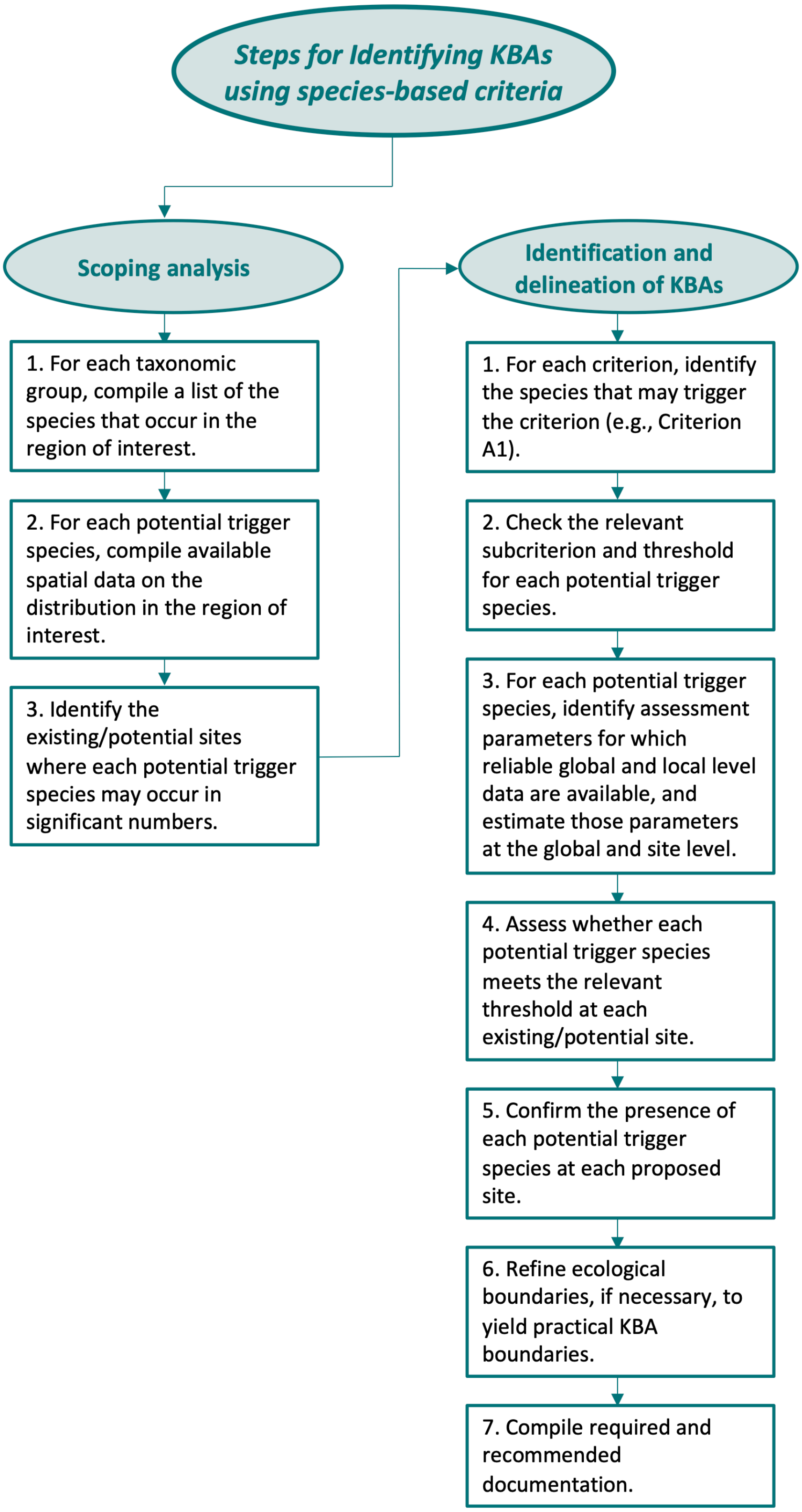

Figure 2.1 Overview of possible workflow for applying Criteria A1, B1-3, D1-3

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 serve to 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 new information is available on taxonomy, the taxonomy must be updated in the SIS before a KBA proposal can be submitted based on the new information.

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 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 before it can be proposed as a KBA trigger species.

What if new information is available on taxonomy?

If there is a proposed change in the treatment of a species or species complex (e.g., a proposed taxonomic split), the IUCN Red List account for the species and/or the SIS must be updated to incorporate this change 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; the nomenclature will be updated in the WDKBA when it is updated in the SIS.

For taxonomic groups that fall under the remit of an IUCN SSC Red List Authority, any changes to taxonomy in the SIS fall under the purview of the IUCN SSC Red List Authority. KBA Proposers should liaise directly with the designated IUCN SSC Red List Authority.

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 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 2019, 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 thresholds associated with the species-based criteria (i.e. A1, B1-3, D1-3 and E) are designed to be applied at the species level. Subspecies, evolutionarily significant units, or varieties cannot trigger global KBAs. However, a site may qualify under Criterion

A1, B1 or B2 because it holds a threshold proportion of the distinct genetic diversity of a species (see Section 3.10).

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 can trigger Criterion A1e if the species is assessed as unlikely to occur beyond the site. This information should be available in the IUCN Red List account. If it is not, KBA Proposers should confirm with relevant experts that the species is unlikely to occur beyond the site. 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.

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 ≥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 stopover or bottleneck sites along migration corridors.

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 A1, B1-3, and D1, for example. Under D1, the same individuals could even trigger KBAs at multiple stopover 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 2019, 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 2019, 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 all the following conditions are met:

(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 2019, 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 introduction.

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 2019, 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[1], a list of species known to occur in a particular country can be downloaded from the IUCN Red List.

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, national red lists, 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.

[1] 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).

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.

2.3.2 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, and those that have been validated will be provided through the IUCN Red List.

Validated AOO maps will also be provided, 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).

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 could 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

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.

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 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 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 will be provided automatically through the WDKBA when it is fully functional. Until then, this information 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)[2] 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

[2] 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.

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 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?

For species listed as CR(PE) or CR(PEW), only the site at which the species is most likely to occur (if it still exists) can trigger KBA Criterion A1 under subcriterion A1e. For many species listed as CR(PE) or CR(PEW), this corresponds to the locality of the last recorded population. There is no reproductive-units threshold for Criterion A1e.

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 Criterion 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 subcriterion and population-size threshold for each potential trigger species given its threat category.

For each species that can trigger Criterion A1, the relevant subcriterion 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) ≥0.5% of the global population size AND ≥5 reproductive units of a CR or EN species;

b) ≥1% of the global population size AND ≥10 reproductive units of a VU species;

c) ≥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) ≥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 Criterion A (population size reduction) only. 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 only) cannot serve as trigger species for KBA subcriteria A1c and A1d. For example:.

- KBA subcriterion A1c would apply to a species listed only as CR A2, 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 earlier versions of the IUCN Red List Categories and Criteria.

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.)

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.

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 and are intended to ensure that trigger species occur at sites in sufficient numbers to reproduce and maintain the population at the site 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 as it 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, any species is considered geographically restricted if it meets the threshold for B1, regardless of whether the species is identified as restricted-range (as per Criterion B2) or restricted to an ecoregion or bioregion (as per Criterion B3), and regardless of whether it is globally threatened. Some species with broad global distributions have many individuals concentrated in just a few areas within their range limits and may therefore trigger Criterion B1. Any species whose population or distribution is so concentrated in certain places that ≥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 B1 threshold is 10% and 10 reproductive units for all species.

A site qualifies as a KBA under Criterion B1 because it regularly holds ≥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.

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[3] is provided on the

[3] The 10,000 km^2 default threshold will be used for any taxonomic group that has not yet been comprehensively assessed.

KBA website. For other species, KBA Proposers are encouraged to review the guidelines below and consult with their RFP before proceeding with site assessments.

Site analysis should be conducted separately for each taxonomic group. Geographically restricted 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 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). Most taxonomic groups in the standard list of taxonomic groups for applying Criteria B2 and B3 have 10,000-50,000 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.

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 either species with a global range size less than or equal to 10,000 km^2 or the 25% of species in the taxonomic group with the smallest ranges up to a maximum of 50,000 km^2. (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 For each taxonomic group, check the relevant species threshold; the population-size threshold is 1% for all species.

A site qualifies as a KBA under Criterion B2 because it regularly holds ≥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.[4]

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.

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.

[4] 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).

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.

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 assessed[5]:

- if B3a is applicable to the taxonomic group, a list of ecoregion-restricted species will be provided on the KBA website;
- if B3b is applicable to the taxonomic group, a list of bioregion-restricted species will be provided on the KBA website 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 using a consistent methodology, the default is subcriterion B3a if ecoregion-restricted species can be identified, or subcriterion B3c otherwise.

Subcriterion B3c was developed to enable identification of geographically restricted assemblages without reference to ecoregions or bioregions. For several taxonomic

---

[5] Currently Amphibia (B3a), Aves (B3b), Chondrichthyes (B3b), Mammalia (B3b), Myxini (B3b), Sarcoptergyii (B3b).

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 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).

For relevant taxonomic groups that have been comprehensively assessed, the KBA Secretariat will generate a preliminary list of ecoregion-restricted species by overlaying ecoregion templates (Appendix V) on range maps (from the IUCN Red List). Each preliminary list of ecoregion-restricted species will be subject to expert review followed by periodic review thereafter. Following expert review, lists of ecoregion-restricted species will be provided on the KBA website.

KBA NCGs and KBA Proposers interested in developing a list of ecoregion-restricted species for other taxonomic groups are asked to contact their RFP first to avoid duplication of effort. KBA Proposers should use the best available data (range or validated ESH) for each species, not necessarily the same data type for all species. Ecoregion-restricted species need to be restricted to the ecoregion throughout their range, not just in the country or region of interest. For a species to be considered ecoregion-restricted, at least 95% of the global population size should be confined to a single ecoregion (see definition of assemblage). Please see Appendix V for ecoregion templates for terrestrial, freshwater and marine systems.

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).

Bioregion templates for terrestrial, freshwater and marine systems are currently being evaluated and will be provided in Appendix V in due course.

For relevant taxonomic groups that have been comprehensively assessed, a list of bioregion-restricted species will be provided on the KBA website in due course.

KBA NCGs and KBA Proposers interested in developing a list of bioregion-restricted species for other taxonomic groups are asked to contact their RFP first to avoid duplication of effort.

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 Criterion B3 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) ≥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, 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 estimate the number of species restricted to the ecoregion. Note that 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). Note that 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 — it is not sufficient that a species is recognized as congregratory and aggregates somewhere within its range. 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 seamounts[6]. 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 2016a, p. 22) if they form an aggregation at the site.

Sites that support ≥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 ≥10% of the global population size an ≥10 reproductive units.)

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

---

[6] 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 2016a, p. 22).

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 2016a, 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 ≥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.

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. Relevant information will most likely be found through a literature search or expert knowledge.

2.9.2 The D2 threshold is 10% for all species.

A site qualifies as a KBA under Criterion D2 because it supports ≥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.

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 the number of mature individuals that has occurred at each proposed site during periods of environmental stress. 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.)

2.9.4 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 for each assessment parameter, and then compare that to the 10% population-size threshold for Criterion D2. This calculation will be checked in the WDKBA when it is fully functional.

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, germinating, and surviving to maturity; sites where adults deposit a large number of eggs that have a high probability of producing larvae that survive to maturity; and nursery sites where large numbers of larvae settle and have a high probability of growing into juveniles that survive to maturity. 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 ≥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.

For Criterion D3, a site predictably produces propagules, larvae, or juveniles that maintain ≥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.

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 ≥10% of propagules, larvae, or juveniles, under the assumption that these recruitment sources also produce ≥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).

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, 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. 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 by a site. However, area-based assessment parameters should be used cautiously, as species are generally unevenly distributed across their range, area of habitat or even occupancy. Estimating numbers of mature individuals should be prioritised for species that occur at highly variable densities within their range, ESH or AOO or very unevenly distributed among localities. Area-based assessment parameters and localities should not be used 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. Species that exhibit significant fluctuations in both population size and distribution may depend primarily on conservation actions at the land-, water- or seascape scale rather than the site scale of KBAs.

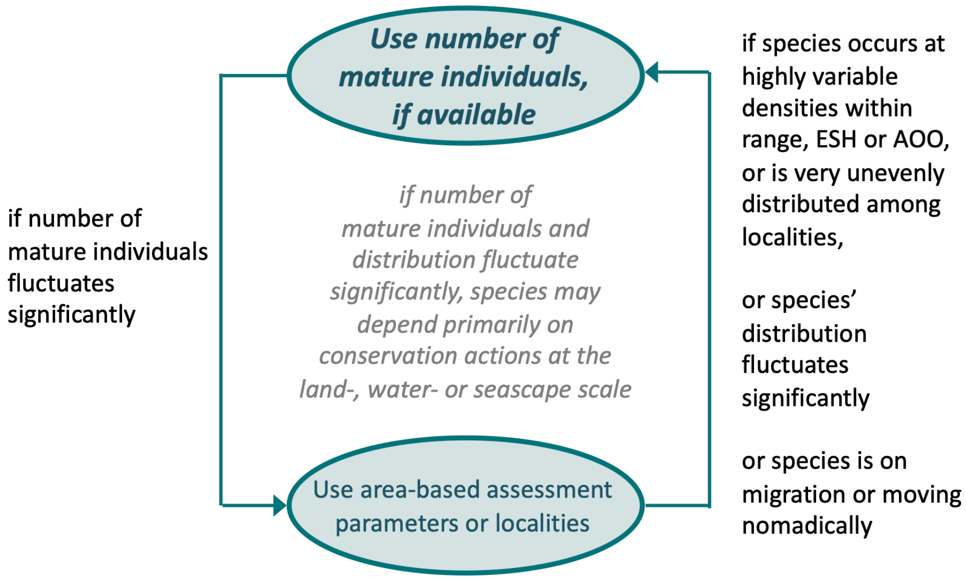

Figure 3.1.1 Selecting between number of mature individuals and area-based assessment parameters or localities

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. 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.

For most species, high quality data will only be available for one or two assessment parameters. An assessment parameter is considered available if it has already been estimated (or can be estimated) consistently at both global and site levels, is complete, recent, reliable and documented.

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).

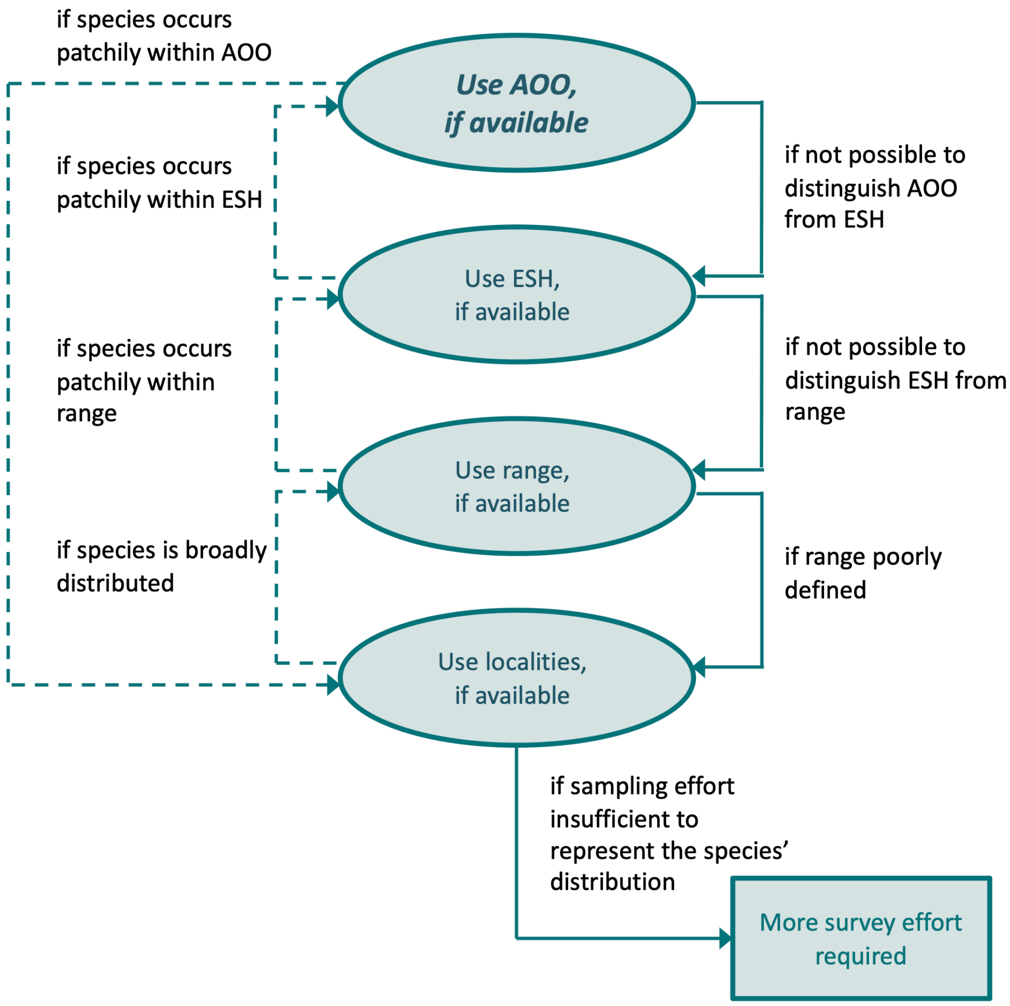

Figure 3.1.2 Selecting among area-based parameters and localities

Global estimates of assessment parameters must be based on the entire range[7]. 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

[7] Only populations considered "wild" should be included in estimates of assessment parameters (see Section 2.2.4).

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 there is no information suggesting that there have 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 a representative sampling strategy; methods for estimating the number of mature individuals need to be appropriate for the species; AOO and ESH should be validated (see Appendix III); range maps should follow the IUCN Red List Mapping Standards (see also Appendix III.1); 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.

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 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.

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

KBA Proposers should also consult with their 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, D1-3 and E the proportion of the global population size can be observed or inferred through any of the following:

(i) number 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 2019). The guidance below is derived from the IUCN Red List Guidelines (IUCN SPC 2019, 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 populations 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.

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?

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, chicks, pups for some seabirds or 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.

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. KBA Proposers should therefore provide evidence that trigger species occur at sites in sufficient numbers to reproduce and maintain the population at the site beyond the current generation. 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.

While some species-based criteria do not require an assessment of the number of reproductive units (e.g., Criteria B2, B3a, B3c, D1), KBA Proposers must still document the presence of the trigger species at the site (except for species listed as CR (PE) or CR (PEW) on the IUCN Red List) and are encouraged to confirm that the site holds at least 10 reproductive units if that information is readily available. 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.

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 (e.g., one pair, one reproductive individual for a monoecious plant species).

For each species, the definition of reproductive units should be derived from the definition of mature individuals. See IUCN Red List Guidelines (IUCN SPC 2019, 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 clones[8].

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,

[8] 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).

KBA Proposers should increase efforts to assess whether the minimum number of reproductive units does indeed occur at the site.

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 should confirm the regular or predictable presence of each trigger species at sites proposed under these criteria (see Section 9.2.3). 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.

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 presently 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 shallow sandy 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 in the same lake as known localities, and projected for similar habitats in a neighbouring lake without 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 voracious predatory fish — the freshwater invertebrate does not occur in these areas, so they are included in ESH but not in AOO.

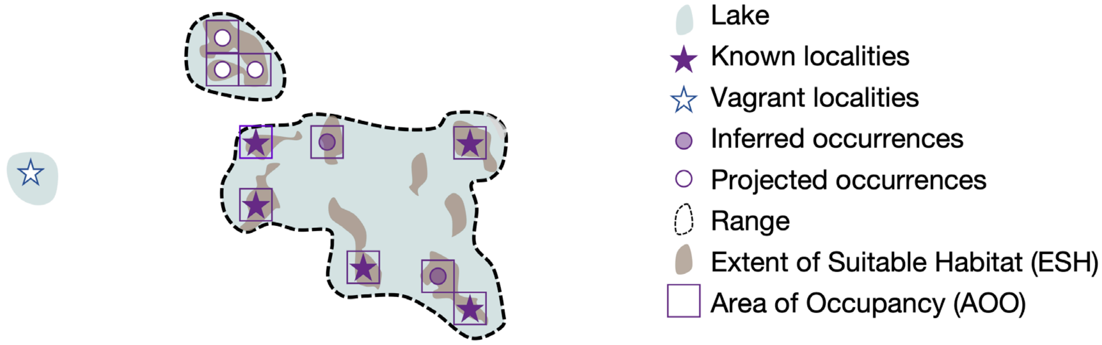

Figure 3.4 Schematic demonstrating localities, range, ESH and AOO for a hypothetical species

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 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 stopover 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=km +no_defs") in a GIS package; 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)[9] 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.

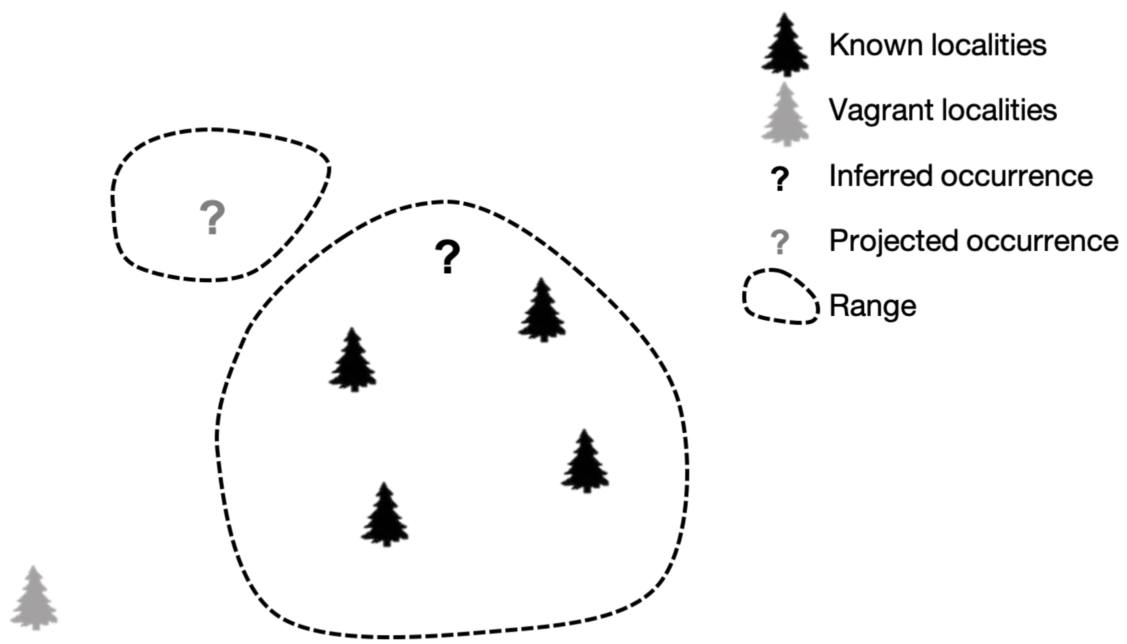

Figure 3.5 Schematic demonstrating range for a hypothetical species

[9] Note that IUCN SPSC (2014) has been updated to IUCN SPS (2019).

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.[10]

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.

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 RFP for expert review and approval.

[10] Note that "range" differs from EOO, which is calculated as the minimum convex polygon around the range. 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.

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.)

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).

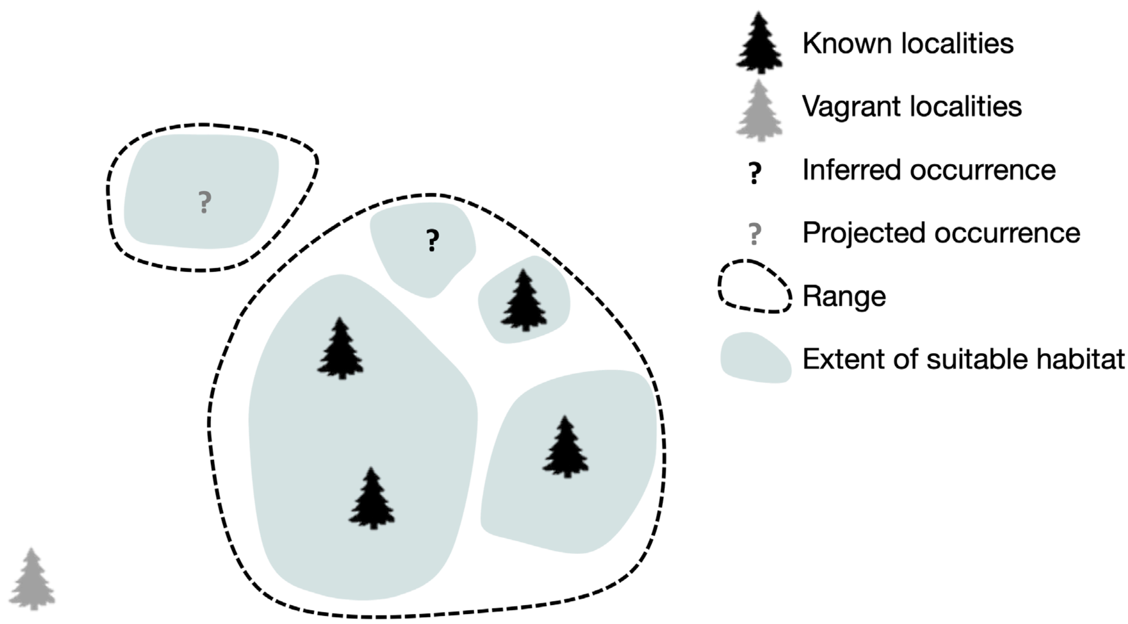

Figure 3.6 Schematic demonstrating extent of suitable habitat (ESH) for a hypothetical species

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.

Note that ESH is equivalent to "area of habitat" (AOH, Brooks et al. 2019). However, as "extent of suitable habitat" is used in the KBA Standard (IUCN 2016), this term is also used in the KBA Guidelines for consistency.

Where can KBA Proposers find data on ESH?

ESH maps are available for several taxonomic groups, including mammals, birds amphibians and some reptiles. 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. Validated ESH maps can be obtained from the KBA Secretariat.

If there is no validated ESH map or the ESH map needs updating, KBA Proposers seeking to use ESH as an assessment parameter should follow the guidance in Appendix III to develop an ESH map. 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). The IUCN Red List Guidelines (IUCN SPC 2019) strongly recommend a reference resolution of 2 x 2 km for all species when measuring AOO, and this is also recommended for KBA assessments.

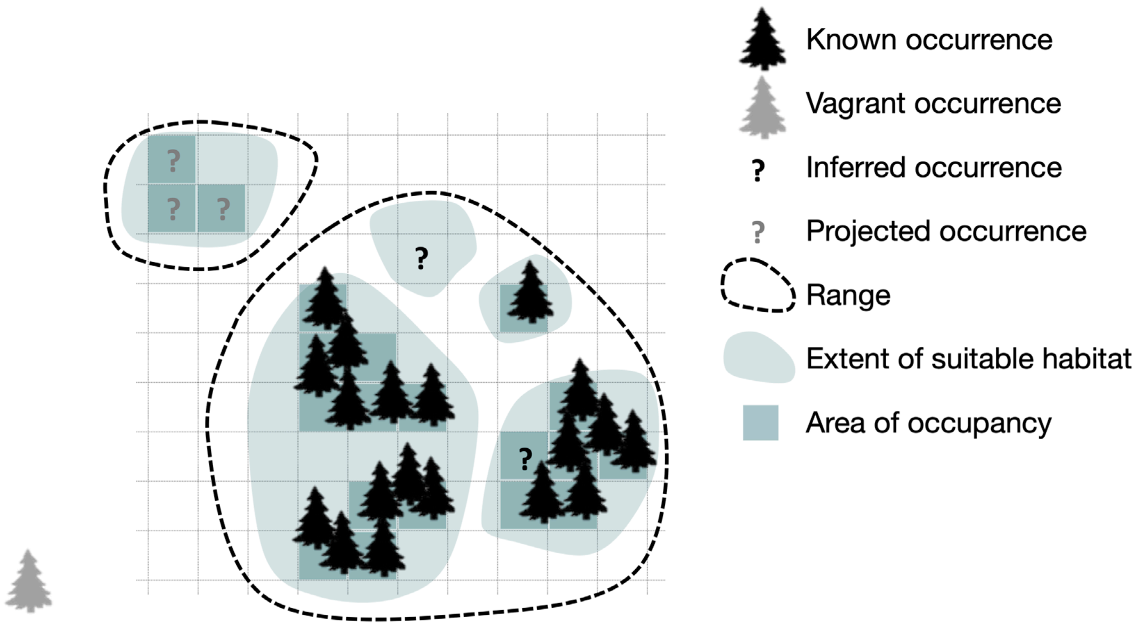

Figure 3.7 Schematic demonstrating area of occupancy (AOO) for a hypothetical species.

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 x 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 also avoid using AOO 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. Number of localities may be a more appropriate assessment parameter in this context.

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 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. 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 ≥1%, a site qualifies as a KBA if it represents one of 100 or fewer localities; where the threshold is ≥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 inappropriate 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 (for example, there are a number of known localities but the factors underpinning the species' distribution are not yet well known).

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 species distribution models (SDMs). 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	

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 separately. 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), or RAD-seq 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 to capture most of the genealogical variance present.

This has led to vigorous debate about how many genomic markers are needed. Traditional AMOVA uses 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 publication[11]. 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, 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

---

[11] 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).

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.

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 RLE Committee on Scientific Standards is currently working to develop a globally consistent ecosystem classification hierarchy (Table 4.2). In this hierarchy, biogeographic ecotypes (Level 4) and global ecosystem types (Level 5) will likely be 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.

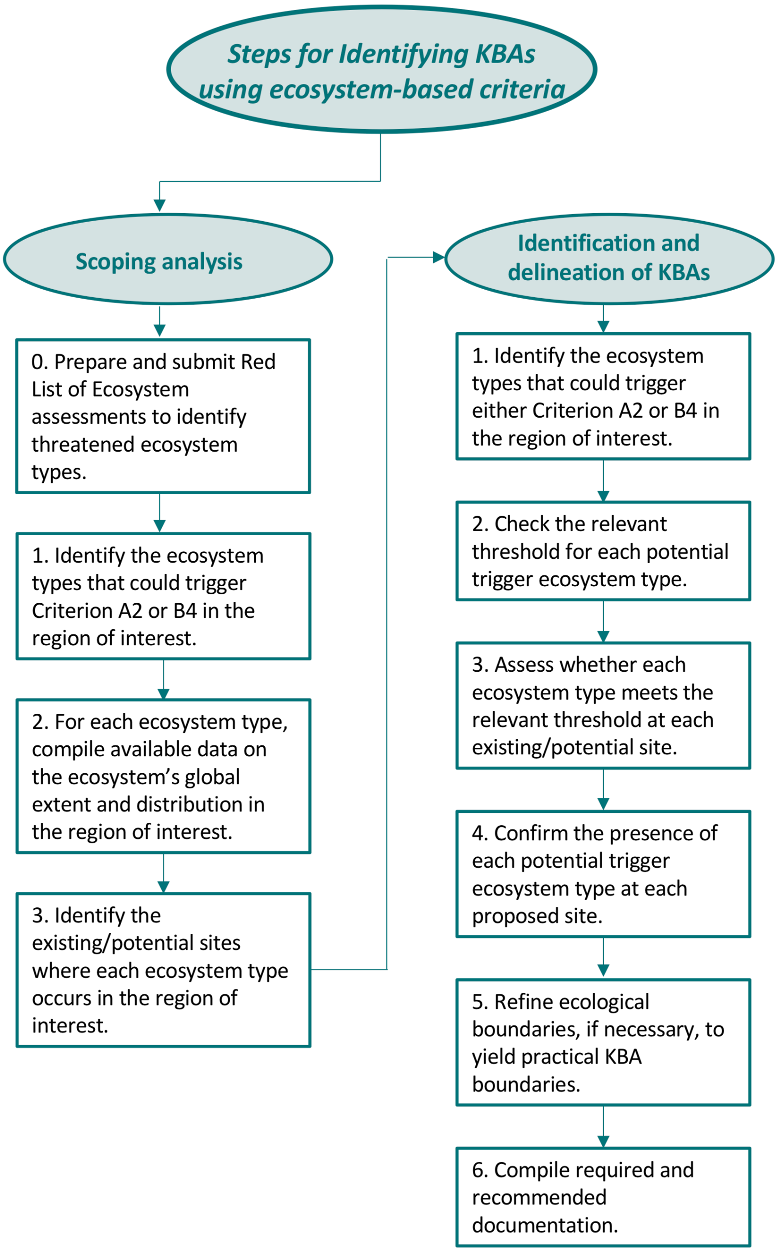

Figure 4.1 Overview of possible workflow for applying Criteria A2 and B4

According to the IUCN Global Ecosystem Typology, biogeographic ecotypes (Level 4) will be 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) will be derived from the bottom up, by aggregating subglobal ecosystem types (Level 6) based on compositional similarities. Subglobal ecosystem types will generally be based on established local classifications (e.g., Mucina & Rutherford 2006).

When applying KBA Criteria A2 and B4, 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.

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 (IUCN 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 (IUCN 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., subglobal ecosystems types at Level 6 in Table 4.2.1) cannot trigger global KBAs, pending further testing.

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

Level	Definition
L1: Realm (e.g., terrestrial)	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., tropical-subtropical forests)	A component of a realm united by one or a few common major ecological drivers that regulate major ecological functions, derived from the top down by subdivision of realms (Level 1).
L3: Ecosystem functional group (e.g., tropical-subtropical lowland rainforests)	A group of related ecosystems within a biome that share common ecological drivers promoting convergence of biotic traits that characterise the group. Derived from the top-down by subdivision of biomes.
L4: Biogeographic ecotype	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	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).
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. 1.01

4.2.3 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.

4.3.3 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 the relevant threshold (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).

4.3 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 (IUCN 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 (IUCN 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) ≥5% of the global extent of a globally CR or EN ecosystem type;

b) ≥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 geographic distribution, representing all spatial occurrences of the ecosystem type (IUCN 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 IUCN 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).

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.

				Ecosystem extent (km²)					
	Red List of Ecosystems category	Criterion	Threshold (%)	Global extent	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

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 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 ≥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 ≥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 truly outstanding examples of ecological integrity at the global scale. For a site to qualify as a KBA under Criterion C, human impacts must not have eroded ecological integrity, as indicated by the full complement of native species (especially species indicative of long-term structural stability and functionality and those known to be sensitive to human impact), natural movement patterns of species, and the unimpeded functioning of ecological processes (e.g., wildfire, free-flowing rivers, and flooding patterns).

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" (IUCN 2016, p. 12). 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). Ecological processes include species' natural movement patterns and natural disturbance regimes, and their natural state is defined relative to the same regionally appropriate benchmark.

Sites qualifying under Criterion C maintain their full complement of species (including long-lived structure-forming plant species and highly mobile predators and herbivores) at natural levels of abundance or biomass sufficient to maintain key ecological functions (Soulé et al. 2003). Sites qualifying under Criterion C are characterised by contiguous natural habitat and are large enough to maintain species populations and intact 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). They have suffered minimal direct industrial anthropogenic disturbance.

How is ecological integrity measured?

Ecological integrity is a multidimensional concept that is difficult to measure directly. For the purposes of identifying sites qualifying under Criterion C, ecological integrity should be observed or, more likely, inferred from evidence based on both:

(1) 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);

AND

(2) 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.

Measures of species composition and abundance/biomass/density across taxonomic groups may be based on indicator species (see Section 5.2.3).

Absence, or very low levels, of direct industrial human impact does not necessarily imply absence, or even low densities, of human inhabitants. For example, some sites with outstanding ecological integrity have been inhabited by indigenous peoples for millennia. Conversely, some sites with very low human population densities have nonetheless undergone extensive loss of ecological integrity due to remote human impacts. Rather, for a site to qualify as a KBA under Criterion C, human impacts must not have eroded ecological integrity (see Section 5.2.1).

How can the regionally appropriate historical benchmark be determined?

The choice of historical benchmark must be consistent with identifying only those sites that are truly outstanding examples of ecological integrity at the global scale, and must be accompanied by an explanation of why it is appropriate to the region (see Stephenson et al. (2019) for discussion).

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 units of analysis for the 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.)

Many ecoregions will not have any remaining areas with the ecological integrity required to qualify as a KBA under Criterion C. Other ecoregions will have potential sites that have been severely affected by pervasive global-scale threats; careful consideration needs to be given to whether these sites meet the requirements to qualify as KBAs under Criterion C.

5.2.1 Conduct a scoping analysis to identify ecoregions with potential for sites that could trigger Criterion C.

In many cases, it will be useful to identify Criterion C KBAs through a step-based process, beginning with regional scoping and following with site evaluation and selection within ecoregions (Fig. 5.2).

Identification of potential areas of outstanding ecological integrity will usually start with a preliminary scoping analysis to identify ecoregions, or areas within ecoregions, with low levels of industrial human impact using readily available global and/or regional-level "human footprint" type datasets (e.g., roads and infrastructure; Sanderson et al. 2002; Venter et al. 2016). This analysis can then be refined using additional data at the ecoregion level, where available.

Preliminary scoping of areas that retain their full complement of native species may be informed by regional maps showing areas where species have been extirpated (see Plumptre et al. 2019 for an example at the global scale). Note that species richness is not a surrogate for ecological integrity. More thorough assessments of species composition and abundance/biomass/densities will be needed at the site-scale (see Section 5.2.3).

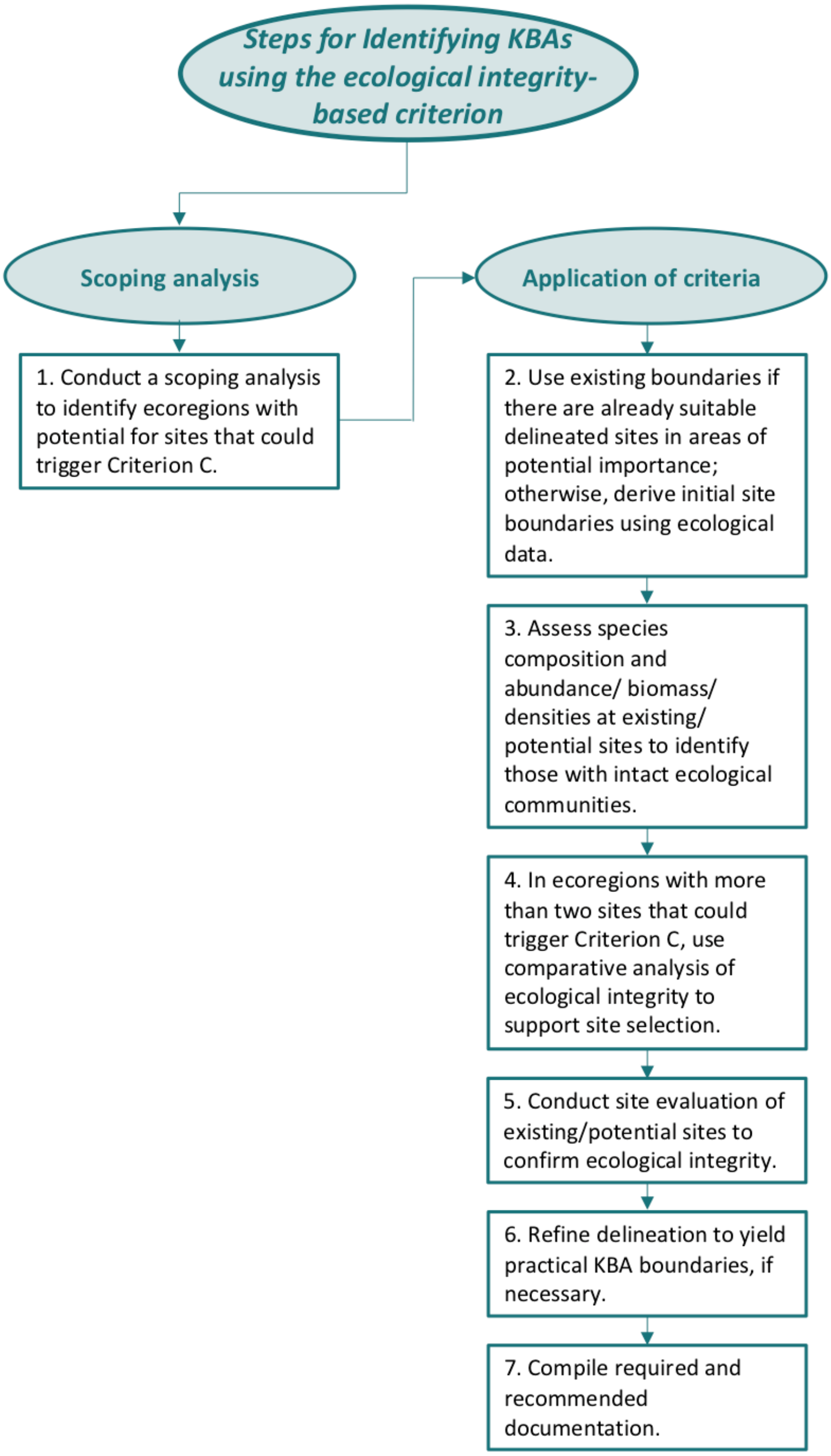

Figure 5.2 Overview of possible workflow for applying Criterion C

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

KBA Proposers may develop quantitative indices based on global/regional/ecoregional datasets and analyse the cumulative impacts of these pressures to identify sites with very low levels of direct industrial human impact. For a site to qualify as a KBA under Criterion C, human impact must not have eroded ecological integrity.

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 sites would be identifiable under Criterion C in this case. However, they may be useful as relative factors, highlighting areas where the impact on ecological integrity is relatively high/moderate/low, for example.

Understanding the key drivers of change within an ecoregion or across similar ecoregions can help to identify the most appropriate datasets and indicators for identifying areas with low levels of direct anthropogenic disturbance. KBA Proposers are encouraged to refer to summaries of the main threats currently affecting or likely to affect any ecosystem types that have been assessed for the Red List of Ecosystems (see IUCN 2017). Some types of infrastructure have different levels of impact in different regions. For example, roads may have limited impacts on ecological integrity in some regions, but lead to broad-scale logging, mining and hunting in others. In regions where indicators of human impact are similar across adjacent ecoregions, the same indices may serve for multiple ecoregions. Elsewhere, ecoregion-specific indices of human impact may be appropriate, especially where more detailed or up-to-date information is available at the ecoregional level than at broader scales.

5.2.2 If there are no suitable delineated sites in areas of potential importance, derive initial KBA boundaries using ecological data.

Some large existing KBAs and other sites of importance for biodiversity (see Section 7.1) may qualify under Criterion C. 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 this case, 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).

Are there any special considerations for delineating sites under Criterion C?

KBAs identified under Criterion C should ideally be delineated to be at least 10,000 km^2 in size, within the confines of manageability. Large sites are generally required to maintain ecological integrity without significant management intervention. Possible exceptions include isolated islands or island-like features (e.g., mountain peaks) with intact ecological communities. KBA size should be sufficient to sustain the life-cycle processes and natural movement patterns of area-demanding species at the site, safeguard other species that are sensitive to human disturbance, and accommodate natural disturbance regimes (see the concept of minimum dynamic area; Pickett & Thompson 1978; Leroux et al. 2007).

For area-demanding species, KBA Proposers should consider the following guidelines adapted from the IUCN Green List:

- The site contains the full range of habitats required to sustain a viable population of the species in the long term, taking account of all relevant life-cycle processes (e.g., breeding areas, wintering grounds, safe migration routes).
- Where the species' range is too large to be protected within a single manageable site:
  - the site contains sufficient habitat area to sustain one or more critical life-cycle processes for a species (e.g., feeding, breeding), and
  - the site is well connected to other protected or managed areas that contain habitats the species needs to complete its life history.

The requirement that all KBAs should be manageable as a unit may, in some cases, constrain the upper size limit of Criterion C KBAs.

In some ecoregions, initial KBA boundaries will be clear because areas with ecological integrity are bounded by areas that clearly do not qualify; whereas, in others, large portions of the ecoregion may exhibit high levels of ecological integrity. (See Section 7.3.3 for guidance in this context.)

Where potential sites are located on both sides of an ecoregion boundary, a single site may be delineated, while recognising that the site on each side of the ecoregion boundary would need to meet the Criterion C threshold in its own right to qualify as a KBA under Criterion C.

5.2.3 Assess species composition and abundance/biomass/densities at existing/potential sites to identify those with intact ecological communities.

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).

How can areas with intact ecological communities be identified?

An ecological community is a complex of native plants, animals and other organisms that interact together within an ecosystem (Smith 1992). Ecological communities are complex and constantly changing due to both natural processes and anthropogenic changes, compounded by climate change. Intactness must be evaluated in this context.

Assessments of species composition and abundance/biomass/densities are essential for the identification of KBAs that qualify under Criterion C. Nevertheless, it is recognised that comprehensive assessments will be impractical in many areas with high ecological integrity, especially in remote ecoregions with few human settlements and limited road access. Ecological assessments may therefore be focused on a set of species indicative of intact ecological communities and ecological processes in their natural state.

KBA NCGs and other KBA Proposers are encouraged to refer to descriptions of the characteristic native biota and key ecological processes and interactions of any ecosystem types that have assessed for the Red List of Ecosystems. Where ecoregions straddle national boundaries, KBA NCGs and KBA Proposers from neighbouring countries are encouraged to discuss and collaborate on identifying a consistent set of indicator species. Conceptual models of key ecosystem dynamics developed as part of Red List of Ecosystems assessments can also provide a useful reference (see IUCN 2017). The set of indicator species should include species indicative of long-term structural stability and functionality (e.g., old structure-forming plants, top predators, other keystone species, ecosystem engineers and foundation species; 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), species that are sensitive to human impact (e.g., all large hunted and harvested species; Redford 1992; Thiollay 1992), and species that indicate ecological condition (e.g., invertebrates and lichens that indicate water and air quality; Karr 1981). The set of indicator species must be accompanied by an explanation of why such species are appropriate and sufficient to infer intactness of ecological communities.

A Criterion C site should contain designated indicator species at ecologically functional densities (Soulé et al. 2003). A simple presence/absence assessment against a list of expected species at the site is not sufficient for assessing ecological integrity, as species may be present at levels well below ecologically functional densities (Soulé et al. 2003).

The significance of a species' loss through anthropogenic causes should be considered in the context of the species' role in maintaining ecological integrity and key ecological processes. If an indicator species has been extirpated through overexploitation, invasive alien species, or disease, but the required habitat/ecosystem conditions still exist at the site, such that the species would be expected to thrive if reintroduced and threats addressed, then the site will not qualify as a Criterion C site now but has the potential to qualify under Criterion C in the future. If a species that is not considered an indicator species for ecological integrity has been extirpated from a site (or has significantly reduced abundance), the KBA Proposer should explain why that species' loss is not detrimental to a Criterion C status.

In addition, assessments of ecological integrity should investigate the occurrence of disease, invasive alien species and other species associated with anthropogenic disturbance, as these may indicate a loss of ecological integrity. As above, the significance of disease and invasive species should be considered in the context of the their role in threatening ecological integrity and key ecological processes.

Given that natural ecosystems are dynamic, assessments of ecological integrity should take into account the expected range of variability in ecosystem composition, structure, and function 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). In some sites, a species might be extirpated or reduced in abundance through natural processes, independent of human impacts.

Can other indicators of ecological integrity be considered?

Information on additional indicators of ecological integrity (e.g., patch size and fragmentation for forests, coral cover for coral reefs, and water quality for rivers and lakes) can provide valuable supporting evidence, but are not a substitute for direct measures of species composition. Use of such indicators should be accompanied by explanations of why they are relevant as indicators of ecological integrity in the ecoregion in question.

5.2.4 In ecoregions with more than two sites that could trigger Criterion C, use comparative analysis of ecological integrity to support site selection.

Sites qualifying under Criterion C represent truly outstanding examples of ecological integrity at the global scale. The maximum number of sites that can qualify under Criterion C is two per ecoregion.

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

In ecoregions with more than two potential sites that could trigger Criterion C, site selection will likely be an iterative process, involving a comparative analysis of factors contributing to ecological integrity (e.g., intactness, size and shape) and manageability based on a combination of desk-based analysis of remotely sensed data, published field surveys and museum records, and site evaluation involving biodiversity knowledge-holders (see Section 5.2.5).

(i) Intactness: Criterion C is based on absolute rather than relative integrity; nevertheless, there may be greater confidence in the intactness of ecological communities at some potential sites than others.

(ii) Size and shape: Large unfragmented areas are generally better able to support highly mobile species, better able to persist through most natural disturbance events, and are more resilient to edge effects. Other factors relating to ecological condition may also be taken into consideration.

As with all KBAs, sites qualifying under Criterion C should be manageable as a unit (see Section 7.3 on delineation).

5.2.5 Conduct site evaluation of existing/potential sites to confirm ecological integrity.

Site evaluation should be conducted prior to proposing any site as a KBA to confirm the presence of intact ecological communities by reviewing recent data or conducting new field surveys if necessary. 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 alien species, and water quality.

Evidence may come from workshops or interviews with biodiversity knowledge-holders, including taxonomic experts, biologists, and holders of Indigenous and Local Knowledge (ILK, see below and Section 8.1), recently collected data or new field surveys. Site evaluation should include interviews with local knowledge-holders and/or new field surveys if assessments of species composition and abundance/ biomass/ densities are based on field surveys that are out-of-date. If the KBA Proposer wants to use data older than 12 years, they should provide a brief explanation of why these data are still considered valid (e.g., no major ecological or human management changes have occurred in the area in the intervening period). Interviews and field surveys 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 all aspects of site evaluation and 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).

5.2.6 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 further guidelines). See Section 8 for guidelines on consultation and involvement of customary rights-holders and other stakeholders.

5.2.7 Compile required and recommended documentation under Criterion C.

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

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

Note. Testing on various aspects of Criterion E is ongoing, as indicated in the text below. KBA NCGs and KBA Proposers interested in identifying KBAs under Criterion E are requested to contact the KBA Secretariat for updates before embarking on data compilation or analysis.

6.1 Overview

Criterion E aims to identify globally irreplaceable sites, specifically sites that contribute significantly to the global persistence of biodiversity because they are very likely needed as part of a global network of complementary sites in which all species are represented at a minimum level (based on predefined representation targets) somewhere in the network. Criterion E is species-based, like criteria A1, B1-3, and D1-3.

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 established representation targets. Typically, there are many possible combinations of complementary sites that can achieve species' representation targets (i.e. the desired amount of a species global population size or distribution), with different spatial configurations. Some of these combinations are more efficient than others, achieving representation targets in a relatively small total area, for example. Sites have high irreplaceability if there are no other sites (or very few other sites) that can replace them without compromising species' representation. Conversely, sites that can easily be replaced by other sites without compromising species' representation are said to have low irreplaceability. Irreplaceable sites are thus important for the goal of representing all species, 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 representation target. 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).

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 the best possible datasets given available data to reduce the need to re-do analyses to account for additional species. These datasets can also inform identification of sites under other species-based KBA criteria.

Sites that qualify under Criterion E are KBAs in their own right, but quantitative analysis of irreplaceability may also serve as a useful scoping tool for Criteria A1 and B1-3. KBA NCGs and KBA Proposers are strongly encouraged to take advantage of this to assess sites identified as highly irreplaceable 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.

Figure 6.1 presents a possible workflow for applying Criterion E. Analysis will generally be conducted in two distinct stages: the first stage is an initial scoping analysis, usually based on equal-area spatial units or other polygons; whereas the second stage is designed to assess the irreplaceability of existing and proposed sites following delineation (see IUCN 2016, p. 25).

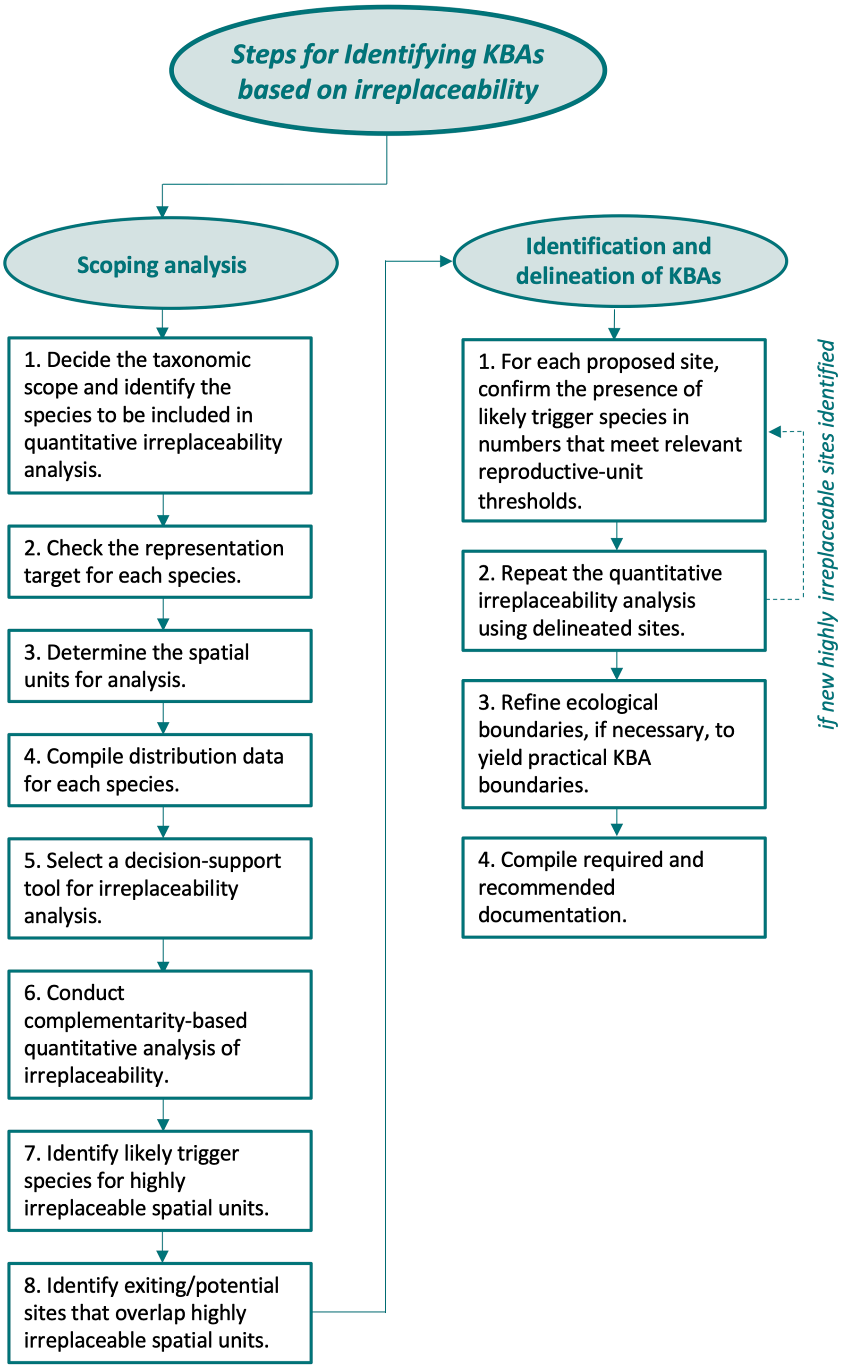

Figure 6.1 Overview of possible workflow for applying Criterion E

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) set the representation targets to reflect the fraction of the global population size of each species that is included in the study area (IUCN 2016, p. 25).

In all three cases (a – c), the analysis 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.

The KBA Standard allows for the inclusion of non-endemic species (c), with representation targets adjusted to reflect the fraction of the global population size in the study region (see Section 6.2.2). Here, we recommend that only species with ≥50% of their population or range within the study region are included in subglobal analysis for Criterion E, pending further testing.[12] (Please contact the KBA Secretariat for updates.) Otherwise, species with a relatively 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 within the study region, despite considerable spatial flexibility outside the study region.

As with all KBAs, assessments of sites as potential KBAs 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 there would otherwise be many non-endemic and edge-of-range species. KBA RFPs should coordinate with KBA NCGs and other KBA Proposers to ensure that sites are not proposed as KBAs based on 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.

6.2 Scoping analysis for KBAs based on irreplaceability through quantitative analysis

6.2.1 Decide the taxonomic scope and identify the species to be included in quantitative irreplaceability analysis in the region of interest.

What is the appropriate taxonomic scope for applying Criterion E?

Criterion E analysis will generally be conducted separately for terrestrial, freshwater, and marine systems.

[12] An alternative approach, to be assessed through testing, may be to use the global population size or distribution for all species, with no adjustment to the target, and then exclude all sites identified as falling outside the region of interest. KBA Proposers interested in testing this option should contact the KBA Secretariat.

For each system, the provisional 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.

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

See Section 2.2 for guidelines on identifying species for inclusion in KBA assessments (including Criterion E). 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 assessing whether the species might occur more widely (Section 2.2.2).

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 Check the representation target for each species.

Under Criterion E, representation targets are set for each species individually, based on the thresholds defined in the KBA Standard (IUCN 2016, pp. 24-25). There are two subcriteria, applicable to species with different types of available data:

- Subcriterion Ea applies 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.
- Subcriterion Eb applies 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.

The two subcriteria mirror each other — for any given species, they describe a consistent level of representation, 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. KBA Proposers are encouraged to set targets in terms of the number of mature individuals where possible, rather than range or AOO, as the number of mature individuals is more directly related to the probability of persistence.

The representation targets should be reduced to comprise the entire population if the global population size is fewer than 1,000 mature individuals, the species' range is less than 1,000 km² or the AOO less than 20 km². Conversely, the representation targets should be increased if quantitative viability analysis indicates that this is necessary to ensure ≥90% probability of global persistence in 100 years. The representation targets are reproduced here, with minor edits for clarification.

(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 ≥90% in 100 years, as measured by quantitative 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 ≥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.

Under subcriterion 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 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.

Figure 6.2 presents the Criterion E representation targets as a flow chart; please refer to the text for details.

Note that, if estimates of average densities within range are available, then the representation target under Eb should correspond to the area necessary to include 1,000 mature individuals subject to a minimum of 1,000 km^2 of range or 20 km^2 of AOO. For example, if the species occurs at average densities of ≥1 mature individual per 1 km^2 of range, then the representation target would be 1,000 km^2 of range; but if it occurs at lower average densities (e.g., 1 mature individual per 10 km^2 of range), then the representation target would be greater (e.g., 10,000 km^2 of range).

For AOO, if the species occurs at average densities of ≥50 mature individuals per 1 km^2 of AOO, then the representation target would be 20 km^2 of AOO; but if it occurs at lower average densities (e.g., 5 mature individuals per 1 km^2 of AOO), then the representation target would be greater (e.g., 200 km^2 of AOO).

Are there guidelines for quantitative viability analysis in subcriteria Eaii and Ebii?

For subcriteria 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 both subcriteria, quantitative viability analysis for endemic species (or any species in a global 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).

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 approximately 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.

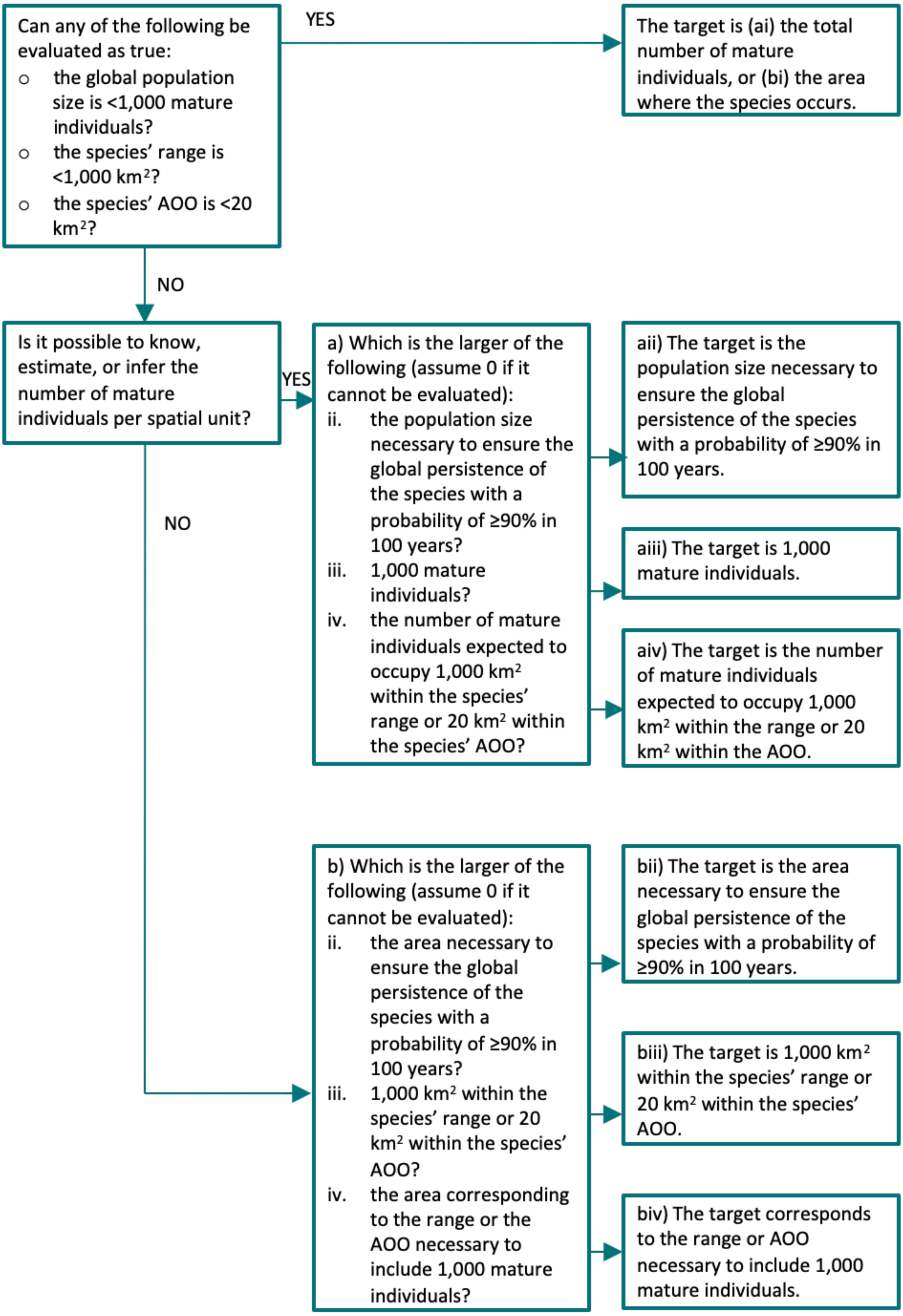

Figure 6.2 Selecting species representation targets for Criterion E

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 ≥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 or 1 km for AOO.[13]

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 km^2 in the breeding range and 1,000 mature individuals or 1,000 km^2 in the non-breeding range).

6.2.3 Determine the spatial units for analysis.

For the purposes of scoping analysis (Fig. 6.1), the study region should be subdivided into grid cells and/or irregular polygons representing subcatchments or existing sites (e.g., existing KBAs, other sites of importance for biodiversity, protected or conserved areas; see Table 7.1 for GIS data on existing sites).

The size of spatial units, whether grid cells or irregular polygons, should generally be consistent with the average or likely size of KBAs in the country or region analysed. Spatial units should not be so large that they are unlikely to be manageable as a unit because large spatial units will need to be partitioned into smaller manageable sites later. The KBA Standard recommends that spatial units should be approximately 100–1,000 km^2 (IUCN 2016, p. 25). HydroBASIN subcatchments at levels 8-12 have an average size within this range. Existing sites substantially larger than 1,000 km^2 may

[13] The scaling ratio is derived from the definition of restricted range, which converts the standard 10,000 km^2 threshold to 500 km for species with linear distributions.

be subdivided into smaller spatial units. These could be used as the basis for zoning in future management plans.

During scoping analysis, 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). The choice of spatial units affects commission errors; whereas the choice of species' distribution data affects both commission and omission errors (see Section 6.2.4).

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 be similar or greater than the resolution of the input data (e.g., if the input data are for cells of 20 x 20 km^2 = 400 km^2, then spatial units should be 400 km^2 or larger).

While minimizing commission errors points towards relatively large spatial units, spatial units should not be so large that they cannot be managed as a unit. Confirmation of species' presence during the second stage of irreplaceability analysis will serve to minimize commission errors at that stage, but over-estimating species occurrence or using spatial units that are too large to be manageable as a unit during the initial scoping stage will be inefficient and frustrating.

Grid cells should be equal-area. If polygons representing existing sites or subcatchments are not approximately equal-area, then they should be weighted by area (e.g., by including area as a cost layer).

6.2.4 Compile distribution data for each species.

Which types of data on the distribution of mature individuals can be used in quantitative irreplaceability analysis under Criterion Ea?

Where available, data on the distribution of mature individuals provide the most direct measure of the contribution of a site to species persistence. 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 km^2 rather than catch-per-unit-effort).

Which types of data on the area where a species occurs can be used in quantitative irreplaceability analysis under Criterion 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; whereas using AOO may risk underestimating the true distribution, leading to omission errors. Testing is ongoing to compare results using range, ESH and AOO. The aim is to find an appropriate balance between risks of commission and omission error. Please contact the KBA Secretariat for updates on testing.

The recent presence of trigger species must ultimately be confirmed in all sites proposed as KBAs. 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 data. Locality data must therefore be converted to AOO prior to quantitative irreplaceability analysis under Criterion Eb.

Range-type datasets:

Range maps for many globally threatened species can be downloaded from the IUCN Red List (see Appendix III.1 for detailed guidelines). 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 Section 3.5).

KBA Proposers are encouraged to use ESH (also known as AOH, see Section 3.6) as a proxy 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 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 if these include large areas of unoccupied habitat. Validated AOO maps will be provided through the IUCN Red List 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 (e.g., 2 x 2 km) 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 smaller grid cells (i.e. <2 x 2 km), they should be scaled up to 2 x 2 km for consistency with the definition of AOO.

6.2.5 Select a decision support tool 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). (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.

Given the various ways that irreplaceability can be estimated, KBA Proposers should clearly document the method used to enable proper review.

6.2.6 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 land-/seascape-level considerations when measuring irreplaceability?

Some decision support tools used in systematic conservation planning include optional features for integrating land-/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 land- or seascapes, these optional features should not be used. When using Marxan or prioritzr, for example, the boundary length modifier or penalty argument should be set to 0. Such land-/seascape-level considerations may be included, along with other factors, in subsequent conservation priority-setting exercises (see IUCN 2016, p. 8).

How is uncertainty handled in quantitative irreplaceability analysis under Criterion E?

KBA Proposers are encouraged to investigate the sensitivity of irreplaceability to potentially significant choices, such as the shape and size of spatial units and the type of data used in setting representation targets (e.g., range or AOO). (See Section 9.3 for more general guidelines on dealing with uncertainty in KBA identification and delineation.)

6.2.7 Identify likely trigger species.

The trigger species for each site are those whose presence at the site explains why irreplaceability exceeds this threshold. A site may hold multiple trigger species.

How can Criterion E trigger species be identified?

Sites may be identified as highly irreplaceable 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 proposed 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, and an extension to conduct this analysis in CLUZ will be released shortly. (Please check with the KBA Secretariat for updates.)

6.2.8 Identify the existing/potential sites that overlap highly irreplaceable spatial units.

Boundaries of existing sites (e.g., existing KBAs, other sites of importance for biodiversity, protected or conserved areas) may be used as spatial units in the initial scoping analysis (Section 6.2.3). If not, boundaries of existing sites should be overlaid on highly irreplaceable spatial units to generate a list of existing sites that might qualify as KBAs under Criterion E. Where this process involves partitioning spatial units into smaller sites, care should be taken to ensure that these sites capture the area(s) within the spatial unit that are driving high levels of irreplaceability. Spatial units should not be partitioned into several distinct sites if the entire spatial unit is required to meet specific representation targets and is manageable as a unit.

In some cases, spatial units that exceed the irreplaceability threshold may fall outside existing sites. In these areas, initial boundaries for potential KBAs may be based on highly irreplaceable spatial units combined with ecological data on the distribution and habitats of likely trigger species (see Section 7.2). Where this process involves partitioning spatial units into smaller sites, care should be taken to ensure that these sites capture the area(s) within the spatial unit that are driving high levels of irreplaceability. Spatial units should not be partitioned into several distinct sites if the entire spatial unit is required to meet specific representation targets and is manageable as a unit.

6.3 Applying Criterion E to identify KBAs based on irreplaceability through quantitative analysis

6.3.1 For each proposed site, confirm the presence of potential trigger species in numbers that meet relevant reproductive-units thresholds.

Once initial KBA boundaries have been derived, the next step is to confirm the presence of each potential trigger species at each site 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.

6.3.2 Repeat the quantitative irreplaceability analysis using delineated sites.

At this point, complementarity-based quantitative analysis should be repeated using delineated sites plus the background grid or polygons used in the scoping analysis, and updated species distribution data, to determine the irreplaceability score of potential KBAs (IUCN 2016, p. 25).

Sites that previously met the 0.9 irreplaceability threshold and have been confirmed to contain the required reproductive units for all likely trigger species may be locked in at this stage, as long as the size has not been reduced. Conversely, the contributions of sites to a particular species' representation target should be set to 0 if it is not possible to confirm the presence of that species or that the reproductive-units threshold is met.

Each spatial unit should be weighted by area at this stage (e.g., by including area as cost layer), as spatial units may vary considerably in size. Large sites may be subdivided into smaller spatial units, which could form the basis for zoning in any future management plan.

If new areas are identified as having very high irreplaceability (i.e. exceeding the 0.9 irreplaceability threshold), return to Step 8 (Section 6.2.8).

6.3.3 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). Involvement of customary rights-holders and stakeholder consultation is important at this stage (see Section 8 for further guidelines). Care should be taken to avoid removing areas that are important for trigger species.

6.3.4 Compile required and recommended documentation under Criterion E.

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

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 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 existing KBA boundaries are modified 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.

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, 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. 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). (See Resolving complex boundary overlaps for further guidance.)

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 resolution to form the basis for delineating manageable KBAs. See the WDKBA, 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, fishing areas); • infrastructure, including cities, ports, roads, shipping lanes.

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

Separate distribution maps are not necessary for biodiversity elements that align with existing KBA boundaries (Section 7.3.1) or the boundaries of other sites of biodiversity importance (Section 7.3.2). However, 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 a whole KBA, maps showing their distribution within the KBA should be submitted with the KBA proposal, where possible, to support monitoring, potential targeted management actions and possible re-delineation in the future. These will be visible in the WDKBA when it is fully functional.

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). However, where this is not possible, topographic and environmental data such as elevation, bathymetry, ridgelines, seamounts, geological features and other identifiable elements of the land/seascape may 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. Any reassessment should involve consensus-building with proposers of the existing KBA(s) to the extent possible. 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 its original trigger biodiversity element(s) unless there is an agreement with the original proposer that it makes sense to do this (see Fig. 7.3.1 for an overview).

Delineation with respect to other sites of biodiversity importance and to protected or conserved areas is treated separately (see Section 7.3.2).

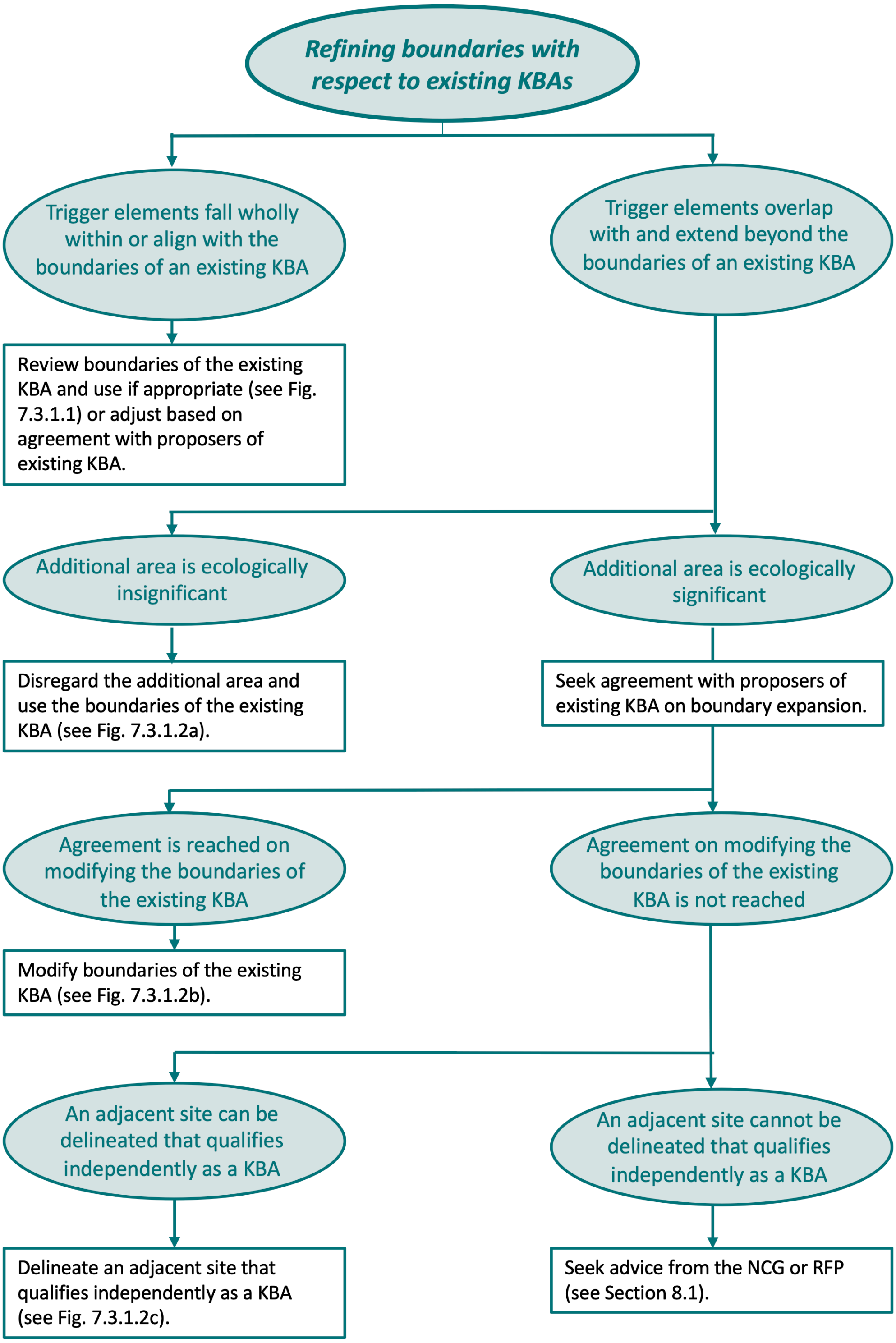

Figure 7.3.1. Refining boundaries with respect to existing KBAs (see text for further details)

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, where possible). 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.

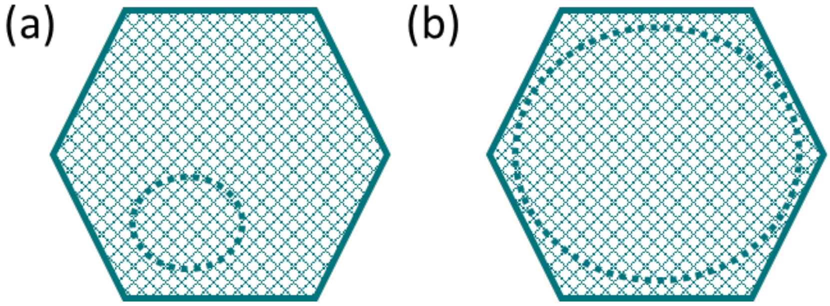

Figure 7.3.1.1 Ecological boundaries for biodiversity elements (a) fall wholly within the boundaries of an existing KBA; or (b) align with the boundaries of an existing KBA. The existing KBA is shown as a hexagon; ecological boundaries are shown as an oval; the proposed KBA is shown as the hatched area. (Note. Regular shapes are used in these cartoon examples for clarity and are not intended to suggest that KBAs are hexagons.)

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 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, and Resolving complex boundary overlaps for further guidance). The case for modifying the existing site 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.

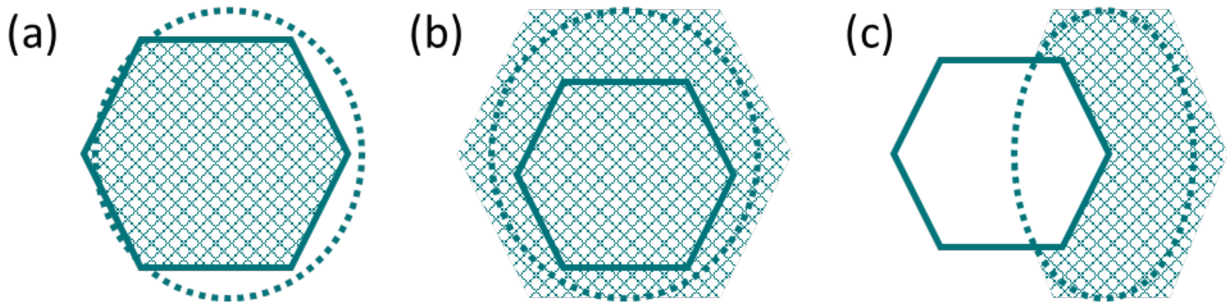

Figure 7.3.1.2 Ecological boundaries for biodiversity elements extend beyond the boundaries of an existing KBA: (a) additional area is ecologically insignificant; (b) boundary of existing KBA is modified to encompass the ecological boundaries of additional biodiversity elements; (c) a new KBA is proposed adjacent to the existing KBA. The existing KBA is shown as a hexagon; ecological boundaries are shown as an oval; the proposed KBA is shown as the hatched area. (Note. Regular shapes are used

in these cartoon examples for clarity and are not intended to suggest that KBAs are hexagons.)

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 (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).

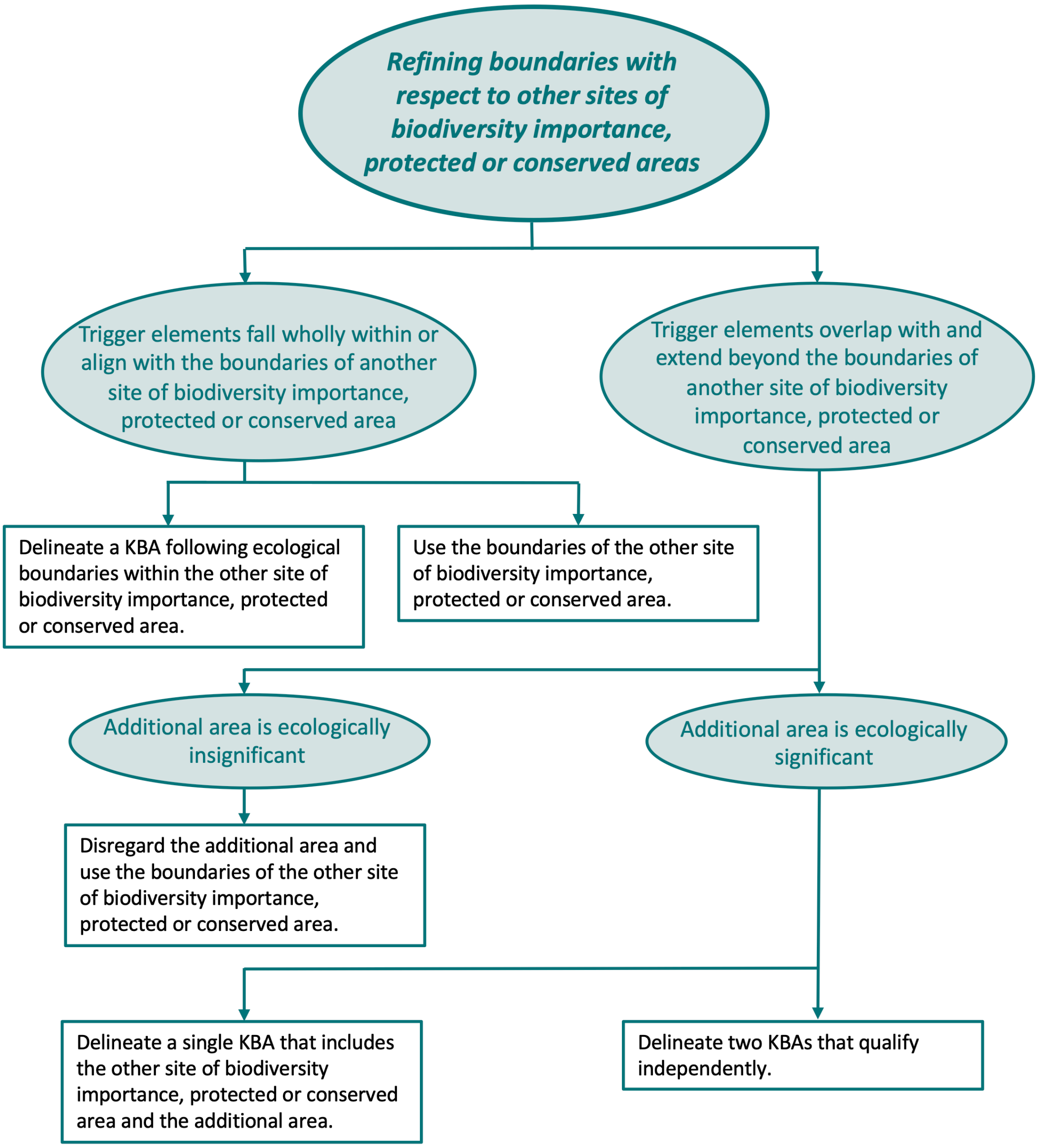

Figure 7.3.2. Refining boundaries with respect to other sites of biodiversity importance, protected or conserved areas

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.

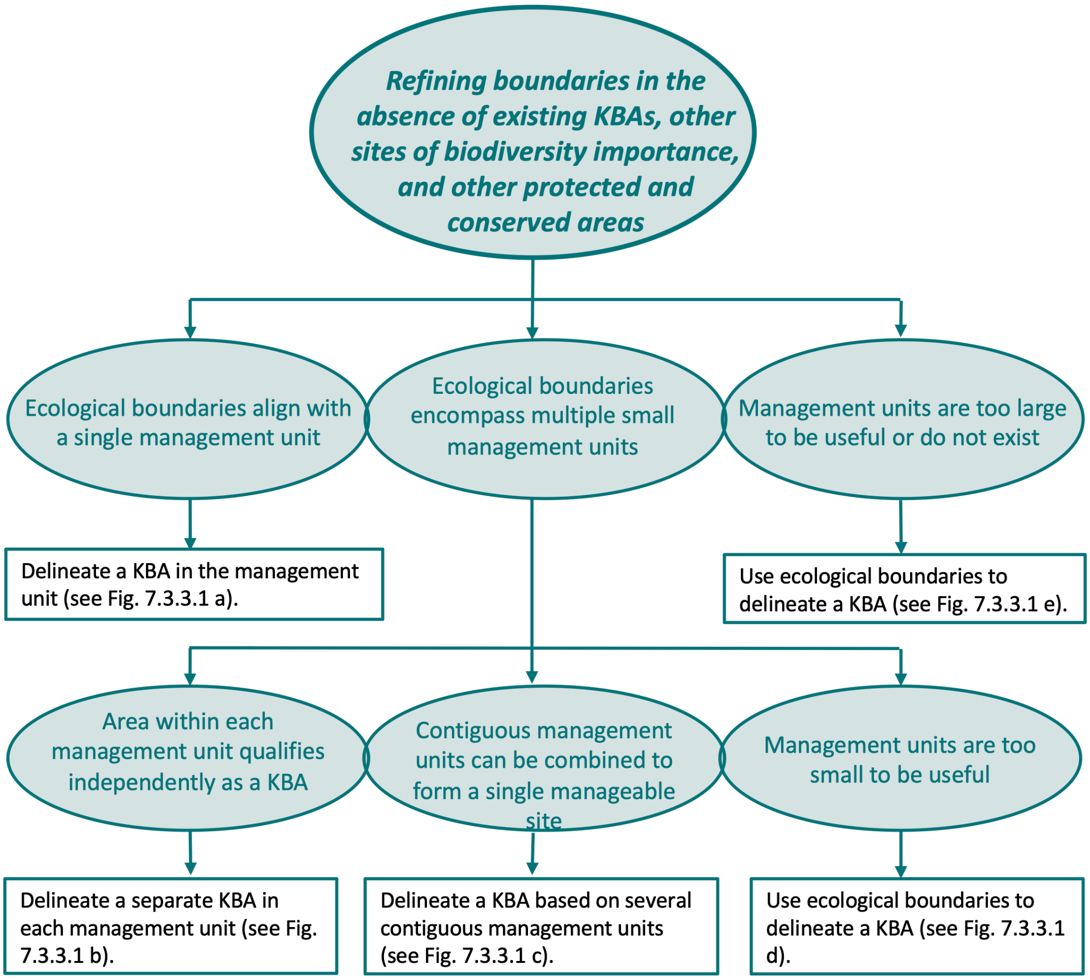

Figure 7.3.3. Refining boundaries in the absence of existing KBAs, other sites of importance for biodiversity, and protected or conserved areas

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).

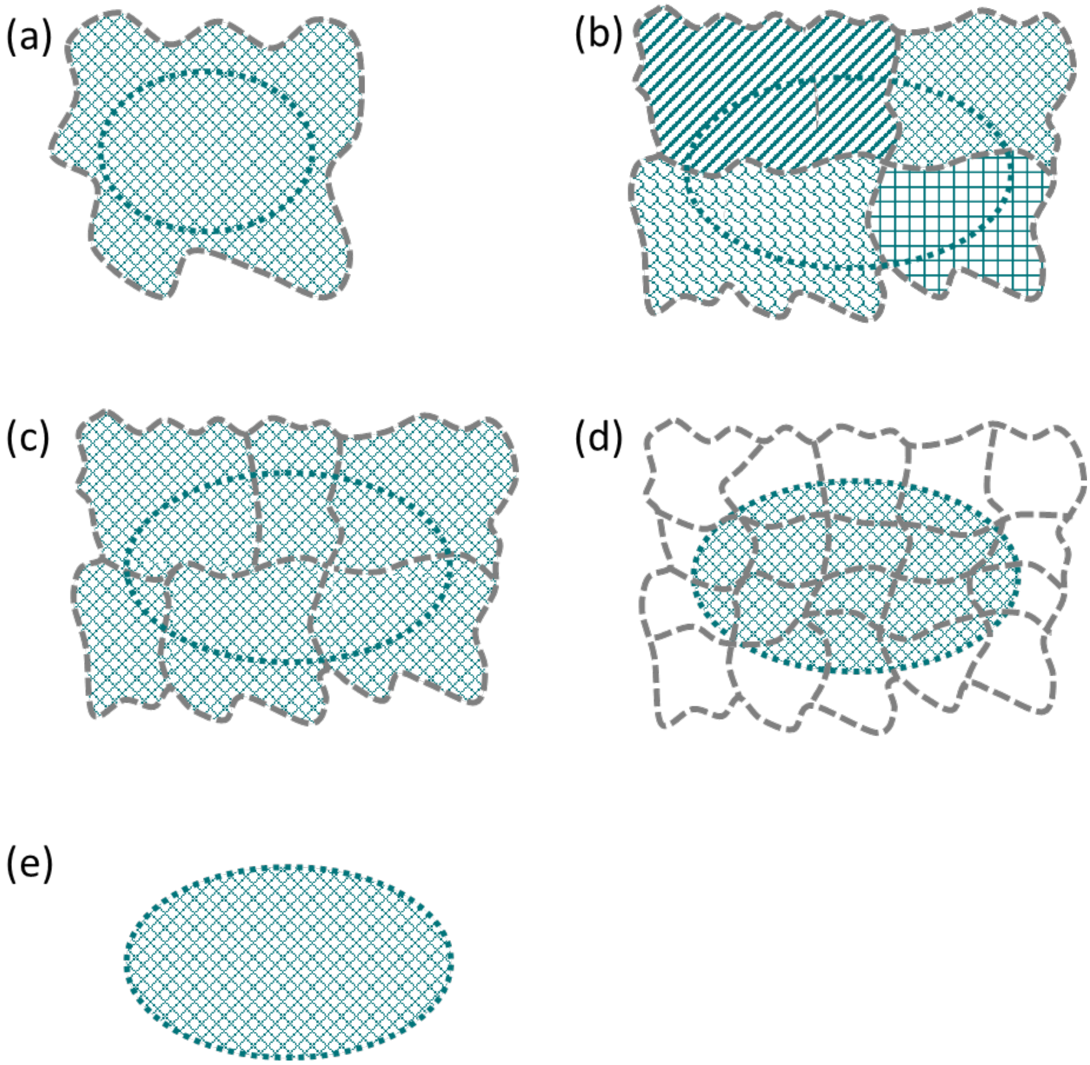

Figure 7.3.3.1 Refining boundaries in the absence of existing sites of importance for biodiversity, protected areas or other conservation areas: (a) a single management unit provides practical KBA boundaries; (b) contiguous management units qualify

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 a dashed boundary; ecological boundaries are shown as an oval; the proposed KBA is shown as the hatched area.

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: 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).

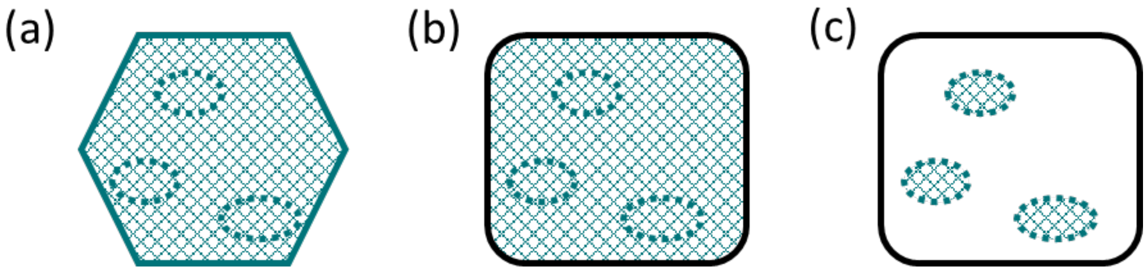

Figure 7.3.4.1 Can a KBA comprise several non-contiguous areas: (a) biodiversity elements occur in patches within an existing KBA; (b, c) biodiversity elements occur in patches within an existing manageable unit such as a protected area — the solution shown in (b) is to delineate a single KBA following the protected area boundaries; whereas the 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 as a hexagon; a protected area is shown as a rectangle; ecological boundaries are shown as ovals; proposed KBAs are shown as the hatched

area. (Note. Regular shapes are used in these cartoon examples for clarity and are not intended to suggest that protected areas are rectangles or KBAs are hexagons.)

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 practical 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. The use of broader-scale catchment levels should be avoided. As with all KBAs, there should be scope for effective management across the site.

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 land-, water- or seascape scale rather than the site scale of KBAs (Boyd et al. 2008; IUCN 2016, p. 4).

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 land- 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.

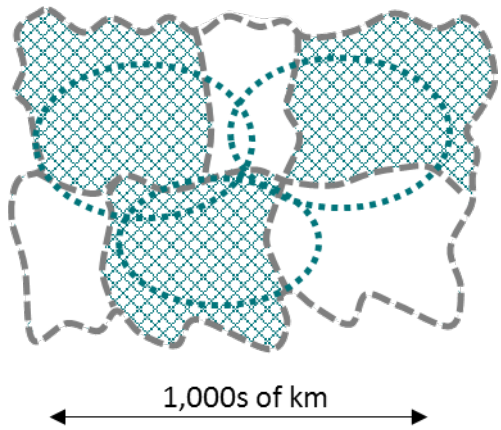

Figure 7.3.4.2 Ecological boundaries overlap and extend to the landscape or seascape scale. Management units are shown as irregular shapes with a dashed boundary; ecological boundaries are shown as ovals; proposed KBAs are shown as hatched areas.

As a practical matter, KBA proposers might find it useful to examine the various biodiversity elements that could trigger a KBA and ask whether there are areas where overlaps are concentrated. If there are two or more areas of concentrated overlaps, the next question is whether these concentration areas share more potential trigger biodiversity elements than are unique to individual concentration areas. It makes sense to separate out any concentration area that has more unique triggering biodiversity elements than it shares with any of the others. This approach provides a starting point for deciding which area of overlaps should be combined and which may be recognized as independent sites. This approach is a modified version of the procedure developed by Stattersfield et al. (1998) for application to landscape-scale areas, but it has also been used in a site-planning context (e.g., Lamoreux et al. 2015).

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 these 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.

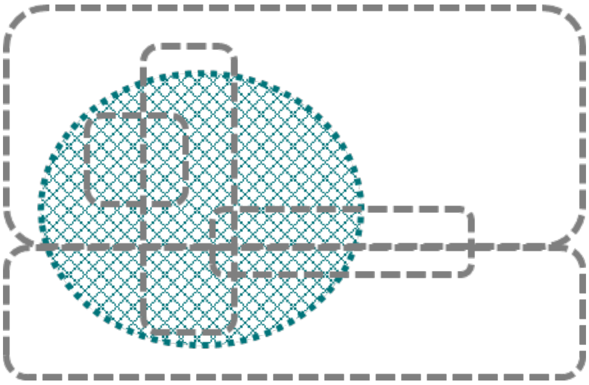

Figure 7.3.4.3. Ecological boundaries encompass multiple overlapping jurisdictions. Management jurisdictions are shown as rectangles; ecological boundaries are shown as an oval; the proposed KBA is shown as the hatched area.

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 publishing details of a confirmed KBA through the WDKBA, 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. Three types of stakeholder consultation or involvement are considered here. These 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 and involvement

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]

[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 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.
- 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) Proposed approach to working with Indigenous and local knowledge provides further guidelines on working with ILK.

Is Free, Prior and Informed Consent (FPIC) required to display KBAs in the WDKBA?

The KBA Proposer is responsible for ensuring that FPIC is granted and documented before displaying information based on previously unpublished ILK in the WDKBA. 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

Consensus-building with proposers of existing KBAs (including AZE sites, IBAs and KBAs identified under previous initiatives) is required before any existing KBA boundaries are modified to account for additional biodiversity elements or additional criteria (see Section 7.3.1). Mechanisms for contacting proposers of existing KBAs will be provided through the WDKBA.

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 also encouraged to consult with proposers and managers of existing KBAs in the area of interest, even if there is no proposed modification to the boundaries, as proposers and managers of existing KBAs may well have relevant information on the occurrence and distribution of biodiversity elements, and managers should be informed of any new KBA trigger biodiversity elements identified for the site.

What happens if proposers of existing KBAs in the area of interest cannot be contacted or do not respond?

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 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 (see the KBA Proposal Process guidance). This text should provide enough information for the KBA NCG, RFP and the KBA Secretariat to understand and assess the decision and rationale.

8.3 Involvement of customary 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 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 and other natural resource-dependent communities (see Section 8.4).

Involvement of legal rights-holders (including land/water/resource owners, managers and users) is also encouraged because it engages them in the process and can help identify 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?

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 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 in the WDKBA 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 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 (i.e. an internet search engine such as Google cannot find these sites).

Given that the WDKBA publishes more detailed information on species distributions than the IUCN Red List, a more precautionary approach is appropriate in the WDKBA. 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 utilized, 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.

In a change from the recommendation in the KBA Guidelines (Ver. 1.0), 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 sharing the information provided. Information included in KBA proposals on sensitive trigger species will be made available to the KBA Secretariat (including RFPs) and possibly to Integrated Biodiversity Assessment Tool (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* 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). Population size may be based on counts of all mature individuals at a site or on counts of mature individuals in sampling areas (e.g., points, transects, quadrats) together with statistical assumptions about sampling (e.g., point sampling, distance sampling). 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. Any statistical assumptions regarding the representativeness of sampling or detectability should be justified in the documentation.

Note that the definition of "observed" here is similar to the definition of "estimated" in the IUCN Red List Guidelines (IUCN SPC 2019, Section 3.1); "estimated" is not used in the KBA Standard, except in the definition of mature individuals.

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 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 2019, 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 2019, 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, 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).

What types of data can be used to confirm species presence?

Confirmation of species presence should, ideally, be based on direct observations of mature individuals. Animal tracking data collected using devices with high location accuracy (e.g., GPS) and camera traps are considered equivalent to direct observations.

For highly 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. With the exception of CR(PE) or CR(PEW) species, presence cannot be inferred simply from the presence of habitat, or habitat maps or models.

What types of data can be used to confirm that the reproductive-units threshold is met?

Confirmation that the reproductive-units threshold is met should, ideally, be based on direct observations of the required number of reproductive units or mature individuals. Animal tracking data collected using devices with high location accuracy (e.g., GPS) are considered equivalent to direct observations.

For highly cryptic species, indirect observations indicating presence of the required number of mature individuals (e.g., active burrows indicating the threshold number of breeding pairs) may be used to infer that the reproductive-units threshold is met.

Reproductive units cannot be inferred from the presence of habitat, habitat maps or models, or from a sample that does not meet the threshold. For example, if the reproductive-units threshold is 10 breeding pairs, it is not sufficient to sample 10% of the habitat and find 1 breeding pair; direct observations or indirect evidence of at least 10 breeding pairs would be required, so the sampling area may need to be expanded.

What types of data can be used to confirm presence of an ecosystem type?

See Section 4.3.4 and 4.4.4.

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, ideally, have been collected within less than 12 years before KBA identification.

Older data should be used conservatively and should not be used for species listed as globally threatened on the IUCN Red List under 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 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 strong and it is very unlikely that the species has been extirpated.

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).

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, the knowledge of one or more named biodiversity knowledge-holders may be used instead. This knowledge should be based on direct or indirect observations as described above and not on inference based on the extent of habitat. Biodiversity knowledge-holders should be able to provide reliable confirmation of species identification. 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.

For each proposed trigger species, KBA Proposers should provide a statement that:

a) confirms that the species has recently been observed 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).

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	✓

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. [14]

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 likely occurs to some extent for all species at all sites, as well as for dynamic ecosystem types (e.g., kelp forests). 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). Ecological variation is often substantial for sites important for biological processes, such as demographic aggregations (D1), ecological refugia (D2), and recruitment (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

[14] 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.

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 median 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.[15]

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 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 ≥ threshold?
Year 1	700	×
Year 2	1,100	✓
Year 3	1,200	✓
Site qualifies?		✓

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.

[15] Note that the mean may be used here, instead of the median, for consistency with the Ramsar criteria.

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

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 1	Observer 2	Observer 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?					✓

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 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.

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 as not restricted-range, or not ecoregion- or bioregion-restricted);
E. *genuine status 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; a change in delineation or manageability).

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 (eight 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.[16]

Earlier reassessment is encouraged, especially in the following circumstances:

- Earlier updates to documentation, and reassessment if appropriate, is encouraged in the case of a *taxonomic change* to a trigger species; or a *change in threat category* of a trigger species or ecosystem type for a site confirmed as a KBA under Criterion A1 or A2.
- Earlier reassessment is also encouraged if *new information* becomes available, or a site suffers a catastrophic event (i.e. a *genuine change*) leading to the irreversible loss of trigger species or ecosystem type, or to loss of a site's ecological integrity).

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

[16] New data showing that the site does not qualify would be required in any KBA Appeals process.

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), 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 Criteria 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 Criteria A1 or A2.
- For each KBA trigger biodiversity element for each confirmed KBA, 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 for each confirmed KBA, 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 (including changes in manageability) indicating that KBA delineation should be re-visited. 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.

What happens if a KBA no longer qualifies because of a genuine increase in the global population size?

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). The site should be reassessed against all the KBA criteria to clarify its status. If it no longer qualifies under any global KBA criteria, , 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). In addition, the site may be highlighted as a conservation success on the IUCN Green List, subject to meeting the IUCN Green List criteria.

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. 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. If this reduction could be reversed 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 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. 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.

References

Abell, R., Thieme, M.L., Revenga, C., Bryer, M., Kottelat, M., Bogutskaya, N., Coad, B., Mandrak, N., Balderas, S.C., Bussing, W., Stiassny, M.L.J., Skelton, P., Allen, G.R., Unmack, P., Naseka, A., Ng, R., Sindorf, N., Robertson, J., Armijo, E., Higgins, J.V., Heibel, T.J., Wikramanayake, E., Olson, D., López, H.L., Reis, R.E., Lundberg, J.G., Pérez, M.H.S. and Petry, P. (2008). 'Freshwater ecoregions of the world: a new map of biogeographic units for freshwater biodiversity conservation'. *BioScience* 58:403-414. DOI: https://doi.org/10.1641/B580507

Amstrup, S.C., McDonald, T.L. and Manly, B.F. (eds.) (2010). *Handbook of capture-recapture analysis*. Princeton, NJ: Princeton University Press. DOI: https://doi.org/10.1515/9781400837717

Ball, I.R., Possingham, H.P. and Watts, M. 2009. 'Marxan and relatives: software for spatial conservation prioritisation'. In: Moilanen, A.,Wilson, K.A., and Possingham, H.P. (eds) *Spatial conservation prioritisation: quantitative methods and computational tools.* pp. 185–195. Oxford, UK: Oxford University Press.

Balmford, A., Mace, G.M. and Ginsberg, J.R. (1998). 'The challenges to conservation in a changing world: putting processes on the map'. In: Mace, G.M., Balmford, A. and Ginsberg, J.R. (eds) *Conservation in a changing world.* pp. 1-28. Cambridge, UK: Cambridge University Press.

Beaumont, M.A. and Nichols, R.A. (1996). 'Evaluating loci for use in the genetic analysis of population structure'. *Proceedings of the Royal Society of London Series B: Biological Sciences* 263:1619-1626. DOI: https://doi.org/10.1098/rspb.1996.0237

Beresford, A.E., Buchanan, G.M., Donald, P.F., Butchart, S.H.M., Fishpool, L.D.C. and Rondinini, C. (2011). 'Minding the protection gap: estimates of species' range sizes and holes in the Protected Area network'. *Animal Conservation* 14:114-116. DOI: https://doi.org/10.1111/j.1469-1795.2011.00453.x

Boyd, C., Brooks, T.M., Butchart, S.H.M., Edgar, G.J., da Fonseca, G.A.B., Hawkins, F., Hoffmann, M., Sechrest, W., Stuart, S.N. and van Dijk, P.P. (2008). 'Spatial scale and the conservation of threatened species'. *Conservation Letters* 1:37-43. DOI: https://doi.org/10.1111/j.1755-263X.2008.00002.x

Brooks T.M., Pimm S.L., Akçakaya H.R., Buchanan G.M., Butchart S.H., Foden W., Hilton-Taylor C., Hoffmann M., Jenkins C.N., Joppa L. and Li B.V. (2019). 'Measuring terrestrial area of habitat (AOH) and its utility for the IUCN Red List'. *Trends in Ecology & Evolution* 34:977-986. DOI: https://doi.org/10.1016/j.tree.2019.06.009

Buckland, S.T., Anderson, D., Burnham, K., Laake, J., Thomas, L. and Borchers, D. (2001). *Introduction to distance sampling: estimating abundance of biological populations*. Oxford: Oxford University Press.

Carignan, V. and Villard, M.A. (2002). 'Selecting indicator species to monitor ecological integrity: A review'. *Environmental Monitoring and Assessment* 78:45-61. DOI: https://doi.org/10.1023/A:1016136723584

Carroll, E.L., Bruford, M.W., DeWoody, J.A., Leroy, G., Strand, A., Waits, L. and Wang, J. (2018). 'Genetic and genomic monitoring with minimally invasive sampling methods'. *Evolutionary Applications* 11:1094-1119. DOI: https://doi.org/10.1111/eva.12600

Darbyshire, I., Anderson, S., Asatryan, A., Byfield, A., Cheek, M., Clubbe, C., Ghrabi, Z., Harris, T., Heatubun, C.D., Kalema, J. and Magassouba, S. (2017). 'Important Plant Areas: revised selection criteria for a global approach to plant conservation'. *Biodiversity and Conservation* 26:1767-1800. DOI: https://doi.org/10.1007/s10531-017-1336-6

Dayton, P.K. (1972). 'Toward an understanding of community resilience and the potential effects of enrichments to the benthos at McMurdo Sound, Antarctica'. *Proceedings of the colloquium on conservation problems in Antarctica.* pp. 81-96. Lawrence, KS: Allen Press.

Didier, K.A., Glennon, M.J., Novaro, A., Sanderson, E.W., Strindberg, S., Walker, S. and Di Martino, S. (2009). 'The Landscape Species Approach: spatially-explicit conservation planning applied in the Adirondacks, USA, and San Guillermo-Laguna Brava, Argentina, landscapes'. *Oryx* 43:476-487. DOI: https://doi.org/10.1017/S0030605309000945

Dinerstein, E., Olson, D., Joshi, A., Vynne, C., Burgess, N.D., Wikramanayake, E., Hahn, N., Palminteri, S., Hedao, P., Noss, R., Hansen, M., Locke, H., Ellis, E.C., Jones, B., Barber, C.V., Hayes, R., Kormos, C., Martin, V., Crist, E., Sechrest, W., Price, L., Baillie, J.E.M., Weeden, D., Suckling, K., Davis, C., Sizer, N., Moore, R., Thau, D., Birch, T., Potapov, P., Turubanova, S., Tyukavina, A., De Souza, N., Pintea, L., Brito, J.C., Llewellyn, O.A., Miller, A.G., Patzelt, A., Ghazanfar, S.A., Timberlake, J., Kloser, H., Shennan-Farpon, Y., Kindt, R., Lilleso, J.P.B., van Breugel, P., Graudal, L., Voge, M., Al-Shammari, K.F. and Saleem, M. (2017). 'An Ecoregion-Based Approach to Protecting Half the Terrestrial Realm'. *BioScience* 67:534-545. DOI: https://doi.org/10.1093/biosci/bix014

Donald, P.F., Fishpool, L.D.C., Ajagbe, A., Bennun, L.A., Bunting, G., Burfield, I.J., Butchart, S.H.M., Capellan, S., Crosby, M.J., Dias, M.P., Diaz, D., Evans, M.I., Grimmet, R., Heath, M., Jones, V.R., Lascelles, B.J., Merriman, J.C., O'Brien, M.O., Ramírez, I., Waliczky, Z. and Wege, D.C. (2018). 'Important Bird and Biodiversity Areas (IBAs): the development and characteristics of a global inventory of key sites for biodiversity'. *Bird Conservation International* 29:177-198. DOI: https://doi.org/10.1017/S0959270918000102

Dunn, D.C., Ardron, J., Bax, N., Bernal, P., Cleary, J., Cresswell, I., Donnelly, B., Dunstan, P., Gjerde, K., Johnson, D. and Kaschner, K. (2014). The Convention on Biological Diversity's ecologically or biologically significant areas: origins, development, and current status. *Marine Policy* 49:137-145. DOI: https://doi.org/10.1016/j.marpol.2013.12.002

Eisenberg, J.F. (1977). 'The evolution of the reproductive unit in the Class Mammalia'. In: J.S. Rosenblatt and B.R. Komisaruk (eds.) *Reproductive Behavior and Evolution.* New York, NY: Plenum Publishing Corporation. DOI: https://doi.org/10.1007/978-1-4684-2625-0_3

Eken, G., Bennun, L., Brooks, T.M., Darwall, W., Fishpool, L.D.C., Foster, M., Knox, D., Langhammer, P., Matiku, P., Radford, E., Salaman, P., Sechrest, W., Smith, M.L., Spector, S. and Tordoff, A. (2004). 'Key biodiversity areas as site conservation targets'. *BioScience* 54:1110-1118. DOI: https://doi.org/10.1641/0006-3568(2004)054[1110:KBAASC]2.0.CO;2

Evans, S., Marren, P. and Harper, M. (2001). *Important Fungus Areas: a provisional assessment of the best sites for fungi in the United Kingdom*, Salisbury, UK: Plantlife International.

Faber-Langendoen, D., Keeler-Wolf, T., Meidinger, D., Tart, D., Hoagland, B., Josse, C., Navarro, G., Ponomarenko, S., Saucier, J.-P., Weakley, A. and Comer, P. (2014). 'EcoVeg: a new approach to vegetation description and classification'. *Ecological Monographs* 84:533–561. DOI: https://doi.org/10.1890/13-2334.1

Ferrier, S., Pressey, R.L. and Barrett, T.W. (2000). 'A new predictor of the irreplaceability of areas for achieving a conservation goal, its application to real-world planning, and a research agenda for further refinement'. *Biological Conservation* 93:303-325. DOI: https://doi.org/10.1016/S0006-3207(99)00149-4

Funk, W.C., McKay, J.K., Hohenlohe, P.A. and Allendorf, F.W. (2012). 'Harnessing genomics for delineating conservation units'. *Trends in Ecology and Evolution* 27:489-496. DOI: https://doi.org/10.1016/j.tree.2012.05.012

Hanson, J., Schuster, R., Morrell, N., Strimas-Mackey, M., Watts, M.E., Arcese, P., Bennett, J. and Possingham, H. P. (2017). 'prioritizr: systematic conservation prioritization in *R'*. *R package*.

IUCN (2012a). *IUCN Red List Categories and Criteria: Version 3.1. Second edition*, Gland, Switzerland and Cambridge, UK: IUCN. Available at: https://portals.iucn.org/library/node/10315

IUCN (2012b). *Guidelines for Application of IUCN Red List Criteria at Regional and National Levels: Version 4.0,* Gland, Switzerland and Cambridge, UK: IUCN. Available at: https://portals.iucn.org/library/node/10336

IUCN (2016). *A Global Standard for the Identification of Key Biodiversity Areas, Version 1.0,* Gland, Switzerland: IUCN. Available at: https://portals.iucn.org/library/node/46259

IUCN (2017). *Guidelines for the application of Red List of Ecosystems Categories and Criteria, Version 1.1.* Bland, L.M., Keith, D.A., Miller, R.M., Murray, N.J. and Rodríguez, J.P. (eds). Gland, Switzerland: IUCN. DOI: https://doi.org/10.2305/IUCN.CH.2016.RLE.3.en

IUCN and World Commission on Protected Areas (WCPA) (2017). *IUCN Green List of Protected and Conserved Areas: Standard, Version 1.1,* Gland, Switzerland: IUCN.

IUCN Standards and Petitions Subcommittee (2014). *Guidelines for using the IUCN Red List Categories and Criteria. Version 11*, Prepared by the Standards and Petitions Subcommittee of the IUCN Species Survival Commission.

IUCN Standards and Petitions Committee (2019). *Guidelines for using the IUCN Red List Categories and Criteria. Version 14*, Prepared by the Standards and Petitions Committee of the IUCN Species Survival Commission. Available at: http://www.iucnredlist.org/documents/RedListGuidelines.pdf

Jachmann, H. (2012). *Estimating abundance of African wildlife: an aid to adaptive management*. Boston, MA: Kluwer Academic Publishers.

Janzen, D.H. (1986). 'The Eternal External Threat'. In*:* M. Soulé (ed.) *Conservation Biology: The Science of Scarcity and Diversity.* pp. 286-303. Sunderland, MA: Sinauer Associates.

Jones, C.G., Lawton, J.H. and Shachak, M. (1994). 'Organisms as ecosystem engineers'. *Oikos* 69:373-386. DOI: https://doi.org/10.2307/3545850

Karr, J.R. (1981). 'Assessment of biotic integrity using fish communities'. *Fisheries* 6:21-27. DOI: https://doi.org/10.1577/1548-8446(1981)006<0021:AOBIUF>2.0.CO;2

Keith, D.A., Rodríguez-Clark, K.M., Nicholson, E., Aapala, K., Alonso, A., Asmussen, M., Bachman, S., Basset, A., Barrow, E.G., Benson, J.S., Bishop, M.J., Bonifacio, R., Brooks, T.M., Burgman, M.A., Comer, P., Comín, F.A., Essl, F., Faber-Langendoen, D., Fairweather, P.G., Holdaway, R.J., Jennings, M., Kingsford, R.T., Lester, R.E., MacNally, R., McCarthy, M.A., Moat, J., Oliveira-Miranda, M.A., Pisanu, P., Poulin, B., Regan, T.J., Riecken, U., Spalding, M.D. and

Zambrano-Martínez, S. (2013). 'Scientific foundations for an IUCN Red List of Ecosystems'. *PLOS One* 8:e62111. DOI: https://doi.org/10.1371/journal.pone.0062111

Lamoreux, J.F., McKnight, M.W. and Cabrera Hernandez, R. 2015. *Amphibian Alliance for Zero Extinction Sites in Chiapas and Oaxaca*, Gland, Switzerland: IUCN. DOI: https://doi.org/10.2305/IUCN.CH.2015.SSC-OP.53.en

Langhammer, P.F., Bakarr, M.I., Bennun, L.A., Brooks, T.M., Clay, R.P., Darwall, W., De Silva, N., Edgar, G.J., Eken, G., Fishpool, L.D.C., da Fonseca, G.A.B., Foster, M.N., Knox, D.H., Matiku, P., Radford, E.A., Rodrigues, A.S.L., Salaman, P., Sechrest, W. and Tordoff, A.W. (2007). *Identification and Gap Analysis of Key Biodiversity Areas: Targets for Comprehensive Protected Area Systems,* Gland, Switzerland: IUCN.

Laurance, W.F., Lovejoy, T.E., Vasconcelos, H.L., Bruna, E.M., Didham, R.K., Stouffer, P.C., Gascon, C., Bierregaard, R.O., Laurance, S.G. and Sampaio, E. (2002). 'Ecosystem decay of Amazonian forest fragments: A 22-year investigation'. *Conservation Biology* 16:605-618. DOI: https://doi.org/10.1046/j.1523-1739.2002.01025.x

Leroux, S.J., Schmiegelow, F.K.A., Lessard, R.B. and Cumming, S.G. (2007). 'Minimum dynamic reserves: A framework for determining reserve size in ecosystems structured by large disturbances'. *Biological Conservation* 138:464-473. DOI: https://doi.org/10.1016/j.biocon.2007.05.012

Margules, C.R. and Pressey, R.L. (2000). 'Systematic conservation planning'. *Nature* 405:243-253. DOI: https://doi.org/10.1038/35012251

Mucina, L. and Rutherford, M.C. (eds.) (2006). *The Vegetation of South Africa, Lesotho and Swaziland,* Pretoria, South Africa: South African National Biodiversity Institute.

Newmark, W.D. (1995). 'Extinction of Mammal Populations in Western North American National Parks'. *Conservation Biology* 9:512-526. DOI: https://doi.org/10.1046/j.1523-1739.1995.09030512.x

Olson, D.M., Dinerstein, E., Wikramanayake, E.D., Burgess, N.D., Powell, G.V., Underwood, E.C., D'amico, J.A., Itoua, I., Strand, H.E., Morrison, J.C. and Loucks, C.J., Allnutt, T.F., Ricketts, T.H., Kura, Y., Lamoreux, J.F., Wettengel, W.W., Hedao, P., and Kassem, K.R. (2001). 'Terrestrial ecoregions of the world: a new map of life on Earth'. *BioScience* 51:933-938. DOI: https://doi.org/10.1641/0006-3568(2001)051[0933:TEOTWA]2.0.CO;2

Paine, R.T. (1969). 'A note on trophic complexity and community stability'. *American Naturalist* 103:91-93. DOI: https://doi.org/10.1086/282586

Pickett, S.T.A. and Thompson, J.N. (1978). 'Patch dynamics and the design of nature reserves'. *Biological Conservation* 13:27-37. DOI: https://doi.org/10.1016/0006-3207(78)90016-2

Plantlife International (2004). *Identifying and Protecting the World's Most Important Plant Areas,* Salisbury, UK: Plantlife International.

Plumptre, A.J., Baisero, D., Jędrzejewski, W., Kühl, H., Maisels, F., Ray, J. C., Sanderson, E.W., Stringberg, S., Voigt, M. and Wich, S. (2019). Are We Capturing Faunal Intactness? A Comparison of Intact Forest Landscapes and the "Last of the Wild in Each Ecoregion". *Frontiers in Forests and Global Change* 2:24. DOI: https://doi.org/10.3389/ffgc.2019.00024

Pressey, R.L., Johnson, I.R. and Wilson, P.D. (1994). 'Shades of irreplaceability: towards a measure of the contribution of sites to a reservation goal'. *Biodiversity and Conservation* 3:242-262. DOI: https://doi.org/10.1007/BF00055941

Ramsar (2018). *Strategic Framework and guidelines for the future development of the List of Wetlands of International Importance of the Convention on Wetlands (Ramsar, Iran, 1971)*. 2018 update. Available at: https://www.ramsar.org/sites/default/files/documents/library/xi.8_annex2_framework_for_new_rsis_e_revcop13.pdf

Redford, K.H. (1992). 'The empty forest'. *BioScience* 42:412-422. DOI: https://doi.org/10.2307/1311860

Ricketts, T.H., Dinerstein, E., Boucher, T., Brooks, T.M., Butchart, S.H.M., Hoffmann, M., Lamoreux, J.F., Morrison, J., Parr, M., Pilgrim, J.D., Rodrigues, A.S.L., Sechrest, W., Wallace, G.E., Berlin, K., Bielby, J., Burgess, N.D., Church, D.R., Cox, N., Knox, D., Loucks, C., Luck, G.W., Master, L.L., Moore, R., Naidoo, R., Ridgely, R., Schatz, G.E., Shire, G., Strand, H., Wettengel, W. and Wikramanayake, E. (2005). 'Pinpointing and preventing imminent extinctions'. *Proceedings of the National Academy of Sciences of the United States of America* 102:18497-18501. DOI: https://doi.org/10.1073/pnas.0509060102

Sanderson, E.W., Jaiteh, M., Levy, M.A., Redford, K.H., Wannebo, A.V. and Woolmer, G. (2002). The human footprint and the last of the wild. *BioScience* 52:891–904. DOI: https://doi.org/10.1641/0006-3568(2002)052[0891:THFATL]2.0.CO;2

Scott, J.M., Norse, E.A., Arita, H., Dobson, A., Estes, J.A., Foster, M., Gilbert, B., Jensen, D.B., Knight, R.L., Mattson, D. and Soulé, M.E. (1999). 'The issue of scale in selecting and designing biological reserves'. In*:* M.E. Soulé and J. Terborgh (eds.) *Continental Conservation, scientific foundations of regional reserve networks.* pp. 19-37. Washington, DC: Island Press.

Smith, R.J. (2019). 'The CLUZ plugin for QGIS: designing conservation area systems and other ecological networks'. *Research Ideas and Outcomes* 5:e33510. DOI: https://doi.org/10.3897/rio.5.e33510

Smith, R.J., Bennun, L., Brooks, T.M., Butchart, S.H., Cuttelod, A., Di Marco, M., Ferrier, S., Fishpool, L.D.C., Joppa, L., Juffe-Bignoli, D., Knight, A.T., Lamoreux, J.F., Langhammer, P., Possingham, H.P., Rondinini, C., Visconti, P., Watson, J.E.M, Woodley, S. Boitani, L., Burgess, N.D., De Silva, N., Dudley, N., Fivaz, F., Game, E.T., Groves, C., Lötter, M., McGowan, J., Plumptre, A.J., Rebelo, A.G., Rodriguez, J.P. and Scaramuzza, C.A.M. (2019). 'Synergies between the key biodiversity area and systematic conservation planning approaches'. *Conservation Letters* 12:e12625. DOI: https://doi.org/10.1111/conl.12625

Smith, R.L. (1992). *Elements of Ecology,* New York, NY: Harper Collins.

Soulé, M.E., Estes, J.A., Berger, J. and Del Rio, C.M. (2003). 'Ecological effectiveness: Conservation goals for interactive species'. *Conservation Biology* 17:1238-1250. DOI: https://doi.org/10.1046/j.1523-1739.2003.01599.x

Spalding, M.D., Agostini, V.N., Rice, J.C. and Grant, S.M. (2012). 'Pelagic provinces of the world: a biogeographic classification of the world's surface pelagic waters'. *Ocean and Coastal Management* 60:19-30. DOI: https://doi.org/10.1016/j.ocecoaman.2011.12.016

Spalding, M.D., Fox, H.E., Allen, G.R., Davidson, N., Ferdaña, Z.A., Finlayson, M.A.X., Halpern, B.S., Jorge, M.A., Lombana, A.L., Lourie, S.A. and Martin, K.D., McManus, E., Molnar, J., Recchia, C.A. and Robertson, J. (2007). 'Marine ecoregions of the world: a bioregionalization of coastal and shelf areas'. *BioScience* 57:573-583. DOI: https://doi.org/10.1641/B570707

Stattersfield, A.J., Crosby, M.J., Long, A.J. and Wege, D.C. 1998. *Endemic Bird Areas of the World: Priorities for Biodiversity Conservation*. BirdLife Conservation Series no. 7. Cambridge, UK: BirdLife International.

Stephenson, P.J., Grace, M.K., Akçakaya, H.R., Rodrigues, A.S., Long, B., Mallon, D.P., Meijaard, E., Rodriguez, J.P., Young, R.P., Brooks, T.M. and Hilton-Taylor, C. (2019). 'Defining the indigenous ranges of species to account for geographic and taxonomic variation in the history of human impacts: reply to Sanderson 2019'. *Conservation Biology* 33:1211-1213. DOI: https://doi.org/10.1111/cobi.13400

Stroud, D.A., Mudge, G.P. and Pienkowski, M.W. (1990). *Protecting internationally important bird sites: a review of the EEC Special Protection Area network in Great Britain,* Peterborough, UK: Nature Conservancy Council.

Stuart, S.N., Wilson, E.O., McNeely, J.A., Mittermeier, R.A. and Rodríguez, J.P. (2010). 'The barometer of life'. *Science* 328:177–177. DOI: https://doi.org/10.1126/science.1188606

Thiollay, J.M. (1992). 'Influence of selective logging on bird species-diversity in a Guianan rain-forest'. *Conservation Biology* 6:47-63. DOI: https://doi.org/10.1046/j.1523-1739.1992.610047.x

Upgren, A., Bernard, C., Clay, R., de Silva, N., Foster, M.N., James, R., Kasecker, T., Knox, D., Rial, A., Roxburgh, L. and Storey, R.J. (2009). 'Key biodiversity areas in wilderness'. *International Journal of Wilderness* 15:14-17.

van Swaay, C.A.M. and Warren, M.S. (2006). 'Prime butterfly areas in Europe: an initial selection of priority sites for conservation'. *Journal of Insect Conservation* 10:5-11. DOI: https://doi.org/10.1007/s10841-005-7548-1

Venter, O., Sanderson, E.W., Magrach, A., Allan, J.R., Beher, J., Jones, K.R., Possingham, H.P., Laurance, W.F., Wood, P., Fekete, B.M., Levy, M.A. and Watson, J.E.M. (2016). Sixteen years of change in the global terrestrial human footprint and implications for biodiversity conservation. *Nature Communications* 7:12558. DOI: https://doi.org/10.1038/ncomms12558

Verschuuren, B., Wild, R., McNeely, J. and Oviedo, G. (eds.) (2010) *Sacred natural sites: conserving nature and culture*. London and Washington DC: Earthscan.

Woodley, S. (2010). Ecological Integrity: A Framework for Ecosystem-Based Management. In: D. N. Cole and Yung L. (eds.) *Beyond Naturalness: Rethinking Park and Wilderness Stewardship in an Era of Rapid Change*. Washington, DC: Island Press.

Index

For each term below, the index identifies the main section(s) where the term is explained or discussed: "S" indicates Section; "A" indicates Appendix.

aggregation, AI, S2.8.1

area of habitat:
  see extent of suitable habitat (ESH)

area of occupancy (AOO), AI, AIII.3, S3.7

assemblage, AI
  bioregion-restricted, S2.7.1
  ecoregion-restricted, S2.7.1

assessment parameters, AII
  area-based, S3.4
  for ecological integrity, S5.2.3
  for ecosystem-based criteria, S4.3.6
  for species-based criteria, S3

biodiversity, AI

biodiversity element, AI

biogeographic ecotype, AI, S4.2

biological process, AI

bioregion, AI, AV.2

climate change, S1.6

complementarity, AI, S6.1

confirmed presence, S1.5
  of ecological integrity, S5.2.5
  of an ecosystem type, S4.3.4, S4.4.4
  of a species, S9.2.3

contributing/contribution, AI

criteria, AII, S1.3
  A1, S2.4
  A2, S4.3
  B1, S2.5
  B2, S2.6
  B3, S2.7
  B4, S4.4
  C, S5
  D1, S2.8
  D2, S2.9
  D3, S2.10
  E, S6
  species-based (Criteria A1, B1-3, D1-3), S2
  ecosystem-based (Criteria A2, B4), S4
  based on ecological integrity (Criterion C), S5
  based on quantitative analysis of irreplaceability (Criterion E), S6

data, S1.10, S9
  availability, S9.1
  quality, S9.2
  sensitivity of, S9.1.1
  uncertainty, S9.3

definitions, A1, S1.12

delineation, S1.7, S7
  initial KBA boundaries, S7.2
  practical KBA boundaries, S7.3

demographic aggregation:
  see aggregation

distinct genetic diversity, AI, S3.10

documentation, S1.13

ecological integrity, AI, S5.1

ecological refugium, S2.9.1

ecoregion, AI, AV.1

ecosystem type, AI, S4.2
global ecosystem type, S4.2

endemic, AI

environmental change, S1.6

environmental stress, AI, S2.9

equivalent system, AI, AVII

existing KBAs:
delineation with respect to, S7.3.1

extent of occurrence (EOO):
of a species, S3.4

extent of an ecosystem type, AIV, S4.2.3

extent of suitable habitat (ESH), AI, AIII.2, S3.6

Free, Prior and Informed Consent (FPIC), S8

geographically restricted, AI
assemblage, S2.7
ecosystem type, S4.4
species, S2.5, S2.6

global, AI

habitat:
map, AIII.4
model, AIII.4

Indigenous and Local Knowledge (ILK), S8.1

industrial human impact:
absence of, S5.2.1

inferred, S9.2.1

intact ecological community, AI, S5.1, S5.2.3

intact species assemblage:
see intact ecological community

irreplaceability, AI, S6.1
decision support tools for quantitative analysis of, AVI, S6.2.5

Key Biodiversity Area (KBA), AI, S1.1

KBA Standard, S1.2

life-cycle process, AI

life-history function, AI

life-history stage, AI

localities, AI
number of, S3.8

location, S3.8

manageability, AI, S7.3

mature individuals, AI
numbers of, S3.2
relative abundance of, S3.9
relative density of, S3.9

micro-organisms, AI

observed, S9.2.1

persistence, AI

population size, AI, S3.1

populations:
introduced, S2.2.4
managed, S2.2.4

predictably, AI, S9.3.2

process:
locally and nationally driven, S1.9

projected, S9.2.2

protected areas:
and KBAs, S1.1
delineation with respect to, S7.3.2

range, AI, AIII.1, S3.5

regularly, AI

reassessment, S1.11, S10
frequency of, S10.2
process, S10.3
reasons for, S10.1

recruitment source, S2.10

reproductive units, AI, S3.3
confirmation of, S9.2.3

restricted range, AI
ecosystem type, S4.4.1
species, S2.6.1

sacred natural sites, S8.1

scoping analysis:
species-based (Criteria A1, B1-3, D1-3), S2.3
ecosystem-based (Criteria A2, B4), S4.2
for ecological integrity (Criterion C), S5.2.1

significant/significantly, AI

site, AI

site evaluation (Criterion C), S5.2.5

species, S2.2
composition and abundance/biomass/densities, S5.2.3
extinct, S2.2.1
only known from the type locality, S2.2.2
migratory, S2.2.3
Possibly Extinct, S2.4.1
Possibly Extinct in the Wild, S2.4.1
restricted-range, S2.6.1
subspecies, S2.2.1
taxonomy, S2.2.1
undescribed, S2.2.1

stakeholder consultation and involvement, S1.8, S8
beyond KBA identification and delineation, S8.4
of customary rights holders, S8.3
of knowledge-holders, S8.1
of proposers of existing KBAs, S8.2

subcriteria, AII, S1.3

target, AI, S6.2.2

taxonomic group, AI
for Criterion B2, S2.6.1
for Criterion B3, S2.7.1

threatened, AI
ecosystem type, S4.3.1
species, S2.4.1

threshold, AI, AII, S1.4

trigger, AI

uncertainty:
see data uncertainty

vagrant, AI

Appendix I: Definitions of terms used in the KBA criteria

The terms used in the KBA Standard (IUCN 2016a) must be clearly understood to ensure that the KBA criteria are applied correctly. The following terms are defined in the KBA Standard (IUCN 2016a, 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).

Assemblage (Criterion B)

A set of species within a taxonomic group having: a) their ranges ≥95% predictably confined to a single ecoregion for at least one life-history stage; b) their ranges ≥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 km^2); 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.

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.

A detailed description of the IUCN Global Ecosystem Typology (Ver. 1.01) was published in 2020. In this hierarchy, biogeographic ecotypes (Level 4) and global ecosystem types (Level 5) are relevant levels for KBA identification (see the IUCN Global Ecosystem Typology Ver. 1.01, 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 equivalent to "area of habitat" (AOH; Brooks et al. 2019). Brooks and colleagues define AOH as "the habitat available to a species, that is, habitat within its range" (Brooks et al. 2019, p. 979). ESH or AOH is typically derived from the mapped range, habitat preferences (based on the IUCN Red List Habitat Classification Scheme), and altitudinal or depth limits.

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)[17] 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

[17] Note that IUCN SPSC (2014) has been updated to IUCN SPS (2019).

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.

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 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.

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.

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.

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 (IUCN 2016b, 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. 1.01, Table 2 for further details.)

Ecological refugium (Criterion D)

In the KBA Standard (IUCN 2016a), 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 (IUCN 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. 1.01, 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 2016a, 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 2016a), 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 2016a).

References

Abell, R., Thieme, M.L., Revenga, C., Bryer, M., Kottelat, M., Bogutskaya, N., Coad, B., Mandrak, N., Balderas, S.C., Bussing, W., Stiassny, M.L.J., Skelton, P., Allen, G.R., Unmack, P., Naseka, A., Ng, R., Sindorf, N., Robertson, J., Armijo, E., Higgins, J.V., Heibel, T.J., Wikramanayake, E., Olson, D., López, H.L., Reis, R.E., Lundberg, J.G., Pérez, M.H.S. and Petry, P. (2008). 'Freshwater ecoregions of the world: a new map of biogeographic units for freshwater biodiversity conservation'. *BioScience* 58:403-414. DOI: https://doi.org/10.1641/B580507

Beresford, A.E., Buchanan, G.M., Donald, P.F., Butchart, S.H.M., Fishpool, L.D.C. and Rondinini, C. (2011). 'Minding the protection gap: estimates of species’ range sizes and holes in the Protected Area network'. *Animal Conservation* 14:114-116. DOI: https://doi.org/10.1111/j.1469-1795.2011.00453.x

Brooks T.M., Pimm S.L., Akçakaya H.R., Buchanan G.M., Butchart S.H., Foden W., Hilton-Taylor C., Hoffmann M., Jenkins C.N., Joppa L. and Li B.V. (2019). ‘Measuring terrestrial area of habitat (AOH) and its utility for the IUCN Red

List'. *Trends in Ecology & Evolution* 34:977-986. DOI: https://doi.org/10.1016/j.tree.2019.06.009

Eisenberg, J.F. (1977). 'The evolution of the reproductive unit in the Class Mammalia'. In*:* J.S. Rosenblatt and B.R. Komisaruk (eds.) *Reproductive Behavior and Evolution.* New York, NY: Plenum Publishing Corporation. DOI: https://doi.org/10.1007/978-1-4684-2625-0_3

Faber-Langendoen, D., Keeler-Wolf, T., Meidinger, D., Tart, D., Hoagland, B., Josse, C., Navarro, G., Ponomarenko, S., Saucier, J.-P., Weakley, A. and Comer, P. (2014). 'EcoVeg: a new approach to vegetation description and classification'. *Ecological Monographs* 84:533–561. DOI: https://doi.org/10.1890/13-2334.1

Ferrier, S., Pressey, R.L. and Barrett, T.W. (2000). 'A new predictor of the irreplaceability of areas for achieving a conservation goal, its application to real-world planning, and a research agenda for further refinement'. *Biological Conservation* 93:303-325. DOI: https://doi.org/10.1016/S0006-3207(99)00149-4

IUCN (2012a). *IUCN Red List Categories and Criteria: Version 3.1. Second edition,* Gland, Switzerland and Cambridge, UK: IUCN.

IUCN (2012b). *Guidelines for Application of IUCN Red List Criteria at Regional and National Levels: Version 4.0,* Gland, Switzerland and Cambridge, UK: IUCN. Available at: https://portals.iucn.org/library/node/10336

IUCN (2014) 'Decisions'. 83rd Meeting of the IUCN Council, Gland (CH), 18-21 May 2014.

IUCN (2016a). *A Global Standard for the Identification of Key Biodiversity Areas, Version 1.0,* Gland, Switzerland: IUCN. DOI: https://portals.iucn.org/library/node/46259

IUCN (2016b). *Guidelines for the application of Red List of Ecosystems Categories and Criteria, Version 1.0.* Bland, L.M., Keith, D.A., Murray, N.J. and Rodríguez, J.P. (eds). Gland, Switzerland: IUCN.

IUCN (2017). *Guidelines for the application of Red List of Ecosystems Categories and Criteria, Version 1.1.* Bland, L.M., Keith, D.A., Miller, R.M., Murray, N.J. and Rodríguez, J.P. (eds). Gland, Switzerland: IUCN. DOI: https://doi.org/10.2305/IUCN.CH.2016.RLE.3.en

IUCN Standards and Petitions Subcommittee (2014). *Guidelines for using the IUCN Red List Categories and Criteria. Version 11*, Prepared by the Standards and Petitions Subcommittee of the IUCN Species Survival Commission.

IUCN Standards and Petitions Committee (2019). *Guidelines for using the IUCN Red List Categories and Criteria. Version 14*, Prepared by the Standards and Petitions

Committee of the IUCN Species Survival Commission. Available at: http://www.iucnredlist.org/documents/RedListGuidelines.pdf

Jenkins, R.E. (1988). 'Information management for the conservation of biodiversity'. In: E.O. Wilson (ed.) *Biodiversity.* Washington, DC: National Academy Press.

Keith, D.A., Rodríguez-Clark, K.M., Nicholson, E., Aapala, K., Alonso, A., Asmussen, M., Bachman, S., Basset, A., Barrow, E.G., Benson, J.S., Bishop, M.J., Bonifacio, R., Brooks, T.M., Burgman, M.A., Comer, P., Comín, F.A., Essl, F., Faber-Langendoen, D., Fairweather, P.G., Holdaway, R.J., Jennings, M., Kingsford, R.T., Lester, R.E., MacNally, R., McCarthy, M.A., Moat, J., Oliveira-Miranda, M.A., Pisanu, P., Poulin, B., Regan, T.J., Riecken, U., Spalding, M.D. and Zambrano-Martínez, S. (2013). 'Scientific foundations for an IUCN Red List of Ecosystems'. *PLOS One* 8:e62111. DOI: https://doi.org/10.1371/journal.pone.0062111

Margules, C.R. and Pressey, R.L. (2000). 'Systematic conservation planning'. *Nature* 405:243-253. DOI: https://doi.org/10.1038/35012251

Olson, D.M., Dinerstein, E., Wikramanayake, E.D., Burgess, N.D., Powell, G.V., Underwood, E.C., D'amico, J.A., Itoua, I., Strand, H.E., Morrison, J.C. and Loucks, C.J., Allnutt, T.F., Ricketts, T.H., Kura, Y., Lamoreux, J.F., Wettengel, W.W., Hedao, P., and Kassem, K.R. (2001). 'Terrestrial ecoregions of the world: a new map of life on Earth'. *BioScience* 51:933-938. DOI: https://doi.org/10.1641/0006-3568(2001)051[0933:TEOTWA]2.0.CO;2

Possingham, H.P., Wilson, K.A., Andelman, S.J. and Vynne, C.H. (2006). 'Protected areas: goals, limitations, and design'. In: M.J. Groom, G.K. Meffe and C.R. Carroll (eds.) *Principles of Conservation Biology.* pp. 509-533. Sunderland, MA: Sinauer Associates Inc.

Pressey, R.L., Johnson, I.R. and Wilson, P.D. (1994). 'Shades of irreplaceability: towards a measure of the contribution of sites to a reservation goal'. *Biodiversity and Conservation* 3:242-262. DOI: https://doi.org/10.1007/BF00055941

Ramsar (2018). *Strategic Framework and guidelines for the future development of the List of Wetlands of International Importance of the Convention on Wetlands (Ramsar, Iran, 1971).* 2018 update. Available at: https://www.ramsar.org/sites/default/files/documents/library/xi.8_annex2_framework_for_new_rsis_e_revcop13.pdf

Rodríguez, J.P., Keith, D.A., Rodríguez-Clark, K.M., Murray, N.J., Nicholson, E., Regan, T.J., Miller, R.M., Barrow, E.G., Bland, L.M., Boe, K., Brooks, T.M., Oliveira-Miranda, M.A., Spalding, M. and Wit, P. (2015). 'A practical guide to the application of the Red List of Ecosystems criteria'. *Philosophical Transactions of The Royal Society B* 370:20140003. DOI: https://doi.org/10.1098/rstb.2014.0003

Spalding, M.D., Agostini, V.N., Rice, J.C. and Grant, S.M. (2012). 'Pelagic provinces of the world: a biogeographic classification of the world's surface pelagic waters'. *Ocean and Coastal Management* 60:19-30. DOI: https://doi.org/10.1016/j.ocecoaman.2011.12.016

Spalding, M.D., Fox, H.E., Allen, G.R., Davidson, N., Ferdaña, Z.A., Finlayson, M.A.X., Halpern, B.S., Jorge, M.A., Lombana, A.L., Lourie, S.A. and Martin, K.D., McManus, E., Molnar, J., Recchia, C.A. and Robertson, J. (2007). 'Marine ecoregions of the world: a bioregionalization of coastal and shelf areas'. *BioScience* 57:573-583. DOI: https://doi.org/10.1641/B570707

UN (1992). *Convention on Biological Diversity*. Available: https://treaties.un.org/doc/Treaties/1992/06/19920605%2008-44%20PM/Ch_XXVII_08p.pdf

Appendix II: Summary of the KBA criteria and thresholds

A. Threatened biodiversity		
A1 Threatened species		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	
A2 Threatened ecosystem types		
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		
B1. Individual geographically restricted species	≥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
B2. Co-occurring geographically restricted species	≥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	
B3. Geographically restricted assemblages		
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
B4. Geographically restricted ecosystem types		
	≥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		
D1. Demographic aggregations		
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
D2. Ecological refugia	≥10% of global population during periods of environmental stress	no. of mature individuals
D3. Recruitment sources	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), Appendix III.3 on estimating area of occupancy (AOO) and Appendix III.4 on inference and projection using habitat maps or models.

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 account[18].

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 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.

KBA Proposers should use the range map in the IUCN Red List assessment coded as follows:

- Presence = 1 (Extant) and 2 (Probably Extant)[19];
- Origin = 1 (Native) and 2 (Reintroduced) and 6 (Assisted Colonisation); and
- any Season code (see below for migratory species).

---

[18] 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.

[19] 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 = 4 (Possibly Extinct), Presence = 5 (Extinct) or Presence = 6 (Presence Uncertain) should be excluded.

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.)

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)[20];
- 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)[21];
- Origin = 1 (Native) and 2 (Reintroduced) and 6 (Assisted Colonisation); and
- Seasonality = 1 (Resident) and 3 (Non-breeding Season) and 5 (Seasonal Occurrence Uncertain).

Estimating range

Please see the IUCN Red List Mapping Standards for detailed guidelines on developing distribution maps for estimating range, if there is no range map for a species or the range map needs updating.

In the documentation, KBA Proposers are requested to include sufficient information on datasets and mapping procedures to enable reproduction of the range map, and describe the process whereby the range map was created (including the degree of expert engagement).

III.2 Estimating extent of suitable habitat (ESH)

ESH is the area of potentially suitable ecological conditions for a species within the species' current range (see Fig. 3.6). Note that ESH is equivalent to "area of habitat" (AOH; Brooks et al. 2019).

---

[20] See previous footnote.

[21] See previous footnote.

Existing data on ESH

Maps of ESH are available for several taxonomic groups, including mammals, birds, amphibians and reptiles. ESH maps should be validated before they can be used in KBA identification. Validated ESH maps will be provided through the IUCN Red List, when available.

Estimating ESH

If there is no validated ESH map or the ESH map needs updating, 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).

Typically, ESH takes into account a species altitudinal/bathymetric limits, other physiological limits (e.g., temperature, salinity), and major habitat types (e.g., land cover, or benthic habitat), as appropriate. (See Appendix III.4 for a more in-depth review of methods.)

ESH maps have been developed for birds (Beresford et al. 2011), mammals (Rondinini et al. 2011), and amphibians (Ficetola et al. 2015). These ESH maps have been developed by 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 applied in marine systems, using bathymetry and other physiological limits (e.g., sea-surface temperature and salinity) together with benthic habitat classes.

An ESH map is typically a raster (i.e. set of grid cells), but may be a polygon. 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.

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-km^2 or 4-km^2 grid cells rather than 100-km^2 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 x 2 km grid cells; a link to a standardised 2 x 2 km grid is provided on the KBA website. KBA Proposers are encouraged to use this grid for ESH where appropriate, but may use other resolutions if the 2 x 2 km grid is not suitable given the species' distribution patterns or the resolution of available data.

The final ESH raster or polygon(s) should include all known, inferred or projected occurrences (including conservation translocations but excluding vagrancies), and all habitat (with unsuitable areas removed). ESH maps should be validated with independent occurrence data.

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).

III.3 Estimating area of occupancy (AOO)

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 will be provided through the IUCN Red List, 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.

The IUCN Red List Guidelines (IUCN SPC 2019, 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.)

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.

AOO maps must be validated with independent occurrence data (IUCN SPC 2019, Section 4.10.7). 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).

III.4 Note on habitat maps and models

Habitat maps show the distribution of habitat for a species and are used as the basis for estimating ESH. Habitat maps may be based primarily on expert knowledge (deductive models) or statistical analysis (inductive models). Statistical habitat models may also be referred to as species distribution models, ecological niche models, bioclimatic models, density distribution models, etc.

For some species, including many pelagic marine species, statistical models may represent the best available method for estimating the distribution of mature individuals.

Mapping habitat based on published data and expert knowledge (deductive models)

This type of approach is well suited to developing consistent binary habitat maps (e.g., ESH maps) for entire taxonomic groups, including data-limited species. It is well suited to sedentary species and species with fixed breeding and/or non-breeding habitats. It is less well suited to species with spatially dynamic habitats, including many pelagic marine species.

Mapping habitat and distribution based on statistical analysis (inductive models)

Habitat models may also be developed 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; Zurrell 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 densities (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 map of habitat (e.g., an ESH map) by selecting areas with high versus low probability of occurrence or high versus low expected densities. Alternatively the results may be used to estimate the absolute or relative distribution of mature individuals directly.

This type of approach requires a large number of sampling localities (presence only, presence/absence, or abundance) and is usually applied to a single species or small group of species because of the data, technical, and computational demands. Statistical analysis can account for variation in sampling effort and detectability. This type of approach is generally better suited than deductive approaches to species with spatially dynamic habitats, including many pelagic marine species.

Validation and review of habitat maps and models used in KBA assessments

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. Any 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. Appropriate methods for statistical model evaluation should be employed, including validation using independent datasets. Habitat maps and models that have not been published in the peer-reviewed literature should be sufficiently rigorous to pass peer review.

References

Beresford, A.E., Buchanan, G.M., Donald, P.F., Butchart, S.H.M., Fishpool, L.D.C. and Rondinini, C. (2011). 'Minding the protection gap: estimates of species' range sizes and holes in the Protected Area network'. *Animal Conservation* 14:114-116. DOI: https://doi.org/10.1111/j.1469-1795.2011.00453.x

Brooks T.M., Pimm S.L., Akçakaya H.R., Buchanan G.M., Butchart S.H., Foden W., Hilton-Taylor C., Hoffmann M., Jenkins C.N., Joppa L. and Li B.V. (2019). 'Measuring terrestrial area of habitat (AOH) and its utility for the IUCN Red List'. *Trends in Ecology & Evolution* 34:977-986. DOI: https://doi.org/10.1016/j.tree.2019.06.009

Elith, J. and Leathwick, J.R. (2009). 'Species distribution models: ecological explanation and prediction across space and time'. *Annual Review of Ecology, Evolution, and Systematics* 40:677-697. DOI: https://doi.org/10.1146/annurev.ecolsys.110308.120159

Ficetola, G.F., Rondinini, C., Bonardi, A., Baisero, D. and Padoa-Schioppa, E. (2015). 'Habitat availability for amphibians and extinction threat: a global analysis'. *Diversity and Distributions* 21:302-311. DOI: https://doi.org/10.1111/ddi.12296

Franklin, J. (2010). *Mapping species distributions: spatial inference and prediction*, Cambridge, UK: Cambridge University Press. DOI: https://doi.org/10.1017/CBO9780511810602

IUCN Standards and Petitions Committee (2019). *Guidelines for using the IUCN Red List Categories and Criteria. Version 14*, Prepared by the Standards and Petitions Committee of the IUCN Species Survival Commission. Available at: http://www.iucnredlist.org/documents/RedListGuidelines.pdf

Rondinini, C., Di Marco, M., Chiozza, F., Santulli, G., Baisero, D., Visconti, P., Hoffmann, M., Schipper, J., Stuart, S.N., Tognelli, M.F. and Amori, G. (2011). 'Global habitat suitability models of terrestrial mammals'. *Philosophical Transactions of the Royal Society of London B: Biological Sciences* 366:2633-2641. DOI: https://doi.org/10.1098/rstb.2011.0113

Zurell, D., Franklin, J., König, C., Bouchet, P.J., Dormann, C.F., Elith, J., Fandos, G., Feng, X., Guillera-Arroita, G., Antoine Guisan, A., Lahoz-Monfort, J.J., Leitão, P.J., Park, D.S., Peterson, A.T., Rapacciuolo, G., Schmatz, D.R., Schröder, B., Serra-Diaz, J.M., Thuiller, W., Yates, K.L., Zimmermann, N.E. and Merow, C. (2020). 'A standard protocol for reporting species distribution models'. *Ecography* 43:1-17. DOI: https://doi.org/10.1111/ecog.04960

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 (IUCN 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 2019, p. 76).

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 IUCN 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 km^2. (Source: IUCN 2017, Box 10.)

References

Andréfouët, S., Muller-Karger, F.E., Robinson, J.A., Kranenburg, C.J., Torres-Pulliza, D., Spraggins, S.A. and Murch, B. (2006). Global assessment of modern coral reef extent and diversity for regional science and management applications: a view from space. In: Suzuki, Y., Nakamori, T., Hidaka, M., Kayanne, H., Casareto, B., Nadaoka, K., Yamano, H. and Tsuchiya, M. (eds.) *Proceedings of 10th International Coral Reef Symposium*. Okinawa, Japan, 28 June-2 July 2004, pp. 1732-1745. Okinawa, Japan: Japanese Coral Reef Society.

Clark, G.F., Raymond, B., Riddle, M.J., Stark, J.S. and Johnston, E.L. (2015). 'Vulnerability of Antarctic shallow invertebrate-dominated ecosystems'. *Austral Ecology* 40:482–491. DOI: https://doi.org/10.1111/aec.12237

Giri, C., Ochieng, E., Tieszen, L., Zhu, Z., Singh, A., Loveland, T.R., Masek, J. and Duke, N. (2011). 'Status and distribution of mangrove forests of the world using earth observation satellite data'. *Global Ecology and Biogeography* 20:154–159. DOI: https://doi.org/10.1111/j.1466-8238.2010.00584.x

Hansen, M.C., Potapov, P.V., Moore, R., Hancher, M., Turubanova, S.A., Tyukavina, A., Thau, D., Stehman, S.V., Goetz, S.J., Loveland, T.R., Kommareddy et al. (2013). 'High-Resolution Global Maps of 21st-Century Forest Cover Change'. *Science* 342:850–853. DOI: https://doi.org/10.1126/science.1244693

IUCN (2017). *Guidelines for the application of Red List of Ecosystems Categories and Criteria, Version 1.1.* Bland, L.M., Keith, D.A., Miller, R.M., Murray, N.J., Rodríguez, J.P. (eds). Gland, Switzerland: IUCN. DOI: https://doi.org/10.2305/IUCN.CH.2016.RLE.3.en

IUCN Standards and Petitions Committee (2019). *Guidelines for using the IUCN Red List Categories and Criteria. Version 14*, Prepared by the Standards and Petitions Committee of the IUCN Species Survival Commission. Available at: http://www.iucnredlist.org/documents/RedListGuidelines.pdf

Mucina, L. and Rutherford, M.C. (eds.) (2006). *The Vegetation of South Africa, Lesotho and Swaziland,* Pretoria, South Africa: South African National Biodiversity Institute.

Pekel, J.F., Cottam, A., Gorelick, N. and Belward, A.S. (2016). 'High-resolution mapping of global surface water and its long-term changes'. *Nature* 540:418-422. DOI: https://doi.org/10.1038/nature20584

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).

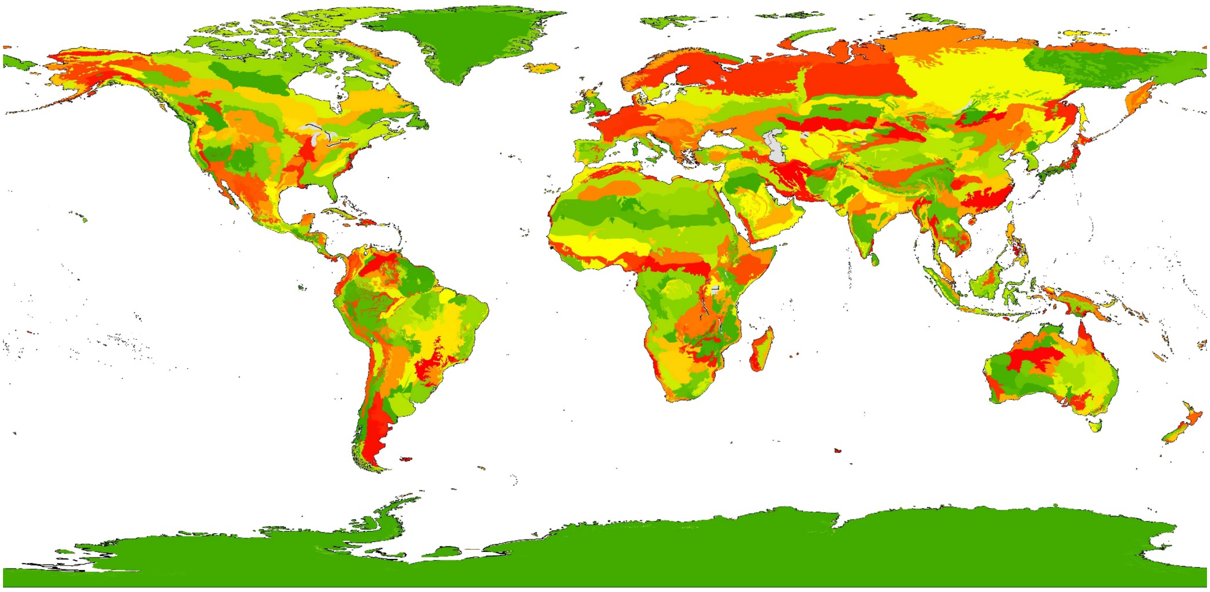

Figure AV.1.1. Terrestrial ecoregions (Dinerstein et al. 2017)

Freshwater ecoregions

The freshwater ecoregion template (Fig. AV.1.2) is taken from Abell et al. (2008).

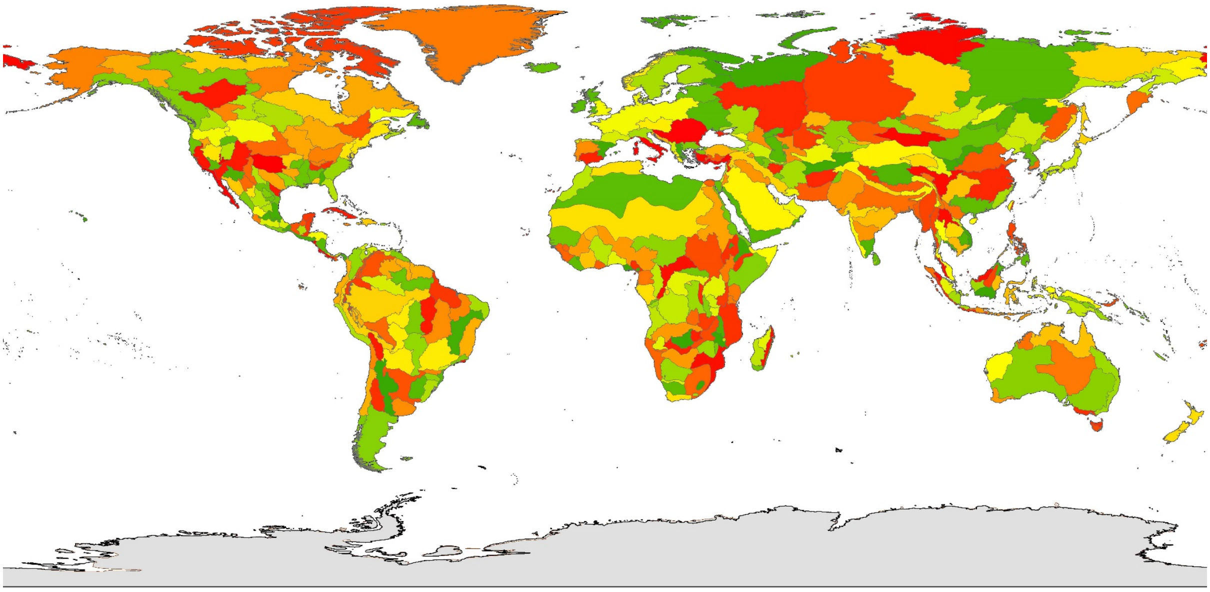

Figure AV.1.2. Freshwater ecoregions (Abell et al. 2008)

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.

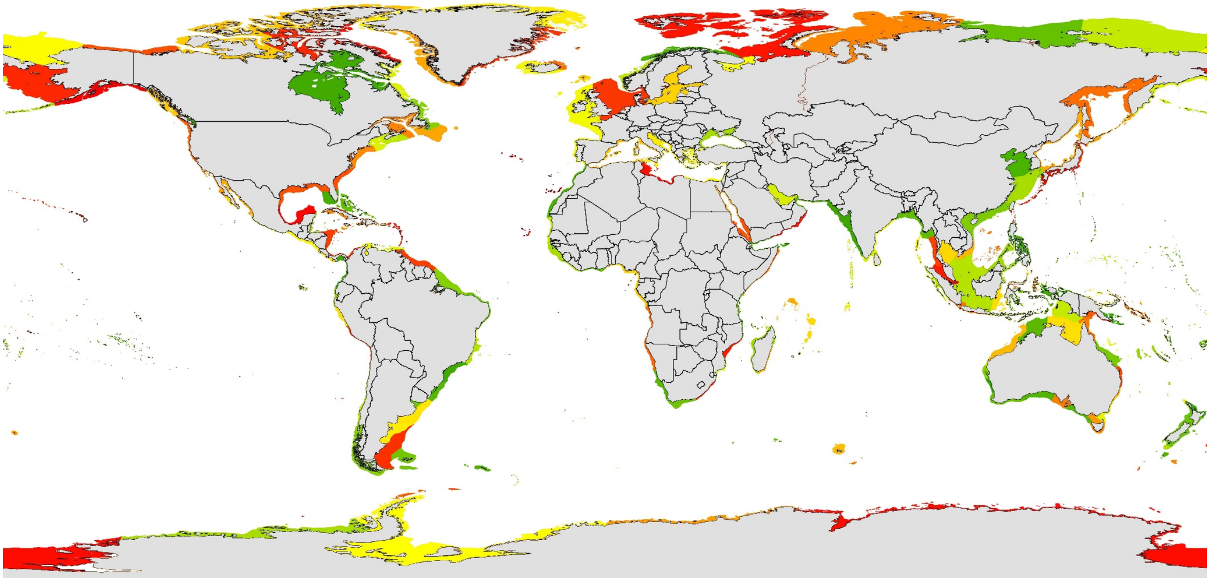

Figure AV.1.3. Marine ecoregions (TNC 2012; based on Spalding et al. 2007, 2012)

V.2 Bioregion templates

Bioregion templates for terrestrial, freshwater and marine systems are currently being evaluated and will be provided in due course.

References

Abell, R., Thieme, M.L., Revenga, C., Bryer, M., Kottelat, M., Bogutskaya, N., Coad, B., Mandrak, N., Balderas, S.C., Bussing, W., Stiassny, M.L.J., Skelton, P., Allen, G.R., Unmack, P., Naseka, A., Ng, R., Sindorf, N., Robertson, J., Armijo, E., Higgins, J.V., Heibel, T.J., Wikramanayake, E., Olson, D., López, H.L., Reis, R.E., Lundberg, J.G., Pérez, M.H.S., and Petry, P. (2008). 'Freshwater ecoregions of the world: a new map of biogeographic units for freshwater biodiversity conservation'. *BioScience* 58:403-414. DOI: https://doi.org/10.1641/B580507

Dinerstein, E., Olson, D., Joshi, A., Vynne, C., Burgess, N.D., Wikramanayake, E., Hahn, N., Palminteri, S., Hedao, P., Noss, R., Hansen, M., Locke, H., Ellis, E.C., Jones, B., Barber, C.V., Hayes, R., Kormos, C., Martin, V., Crist, E., Sechrest, W., Price, L., Baillie, J.E.M., Weeden, D., Suckling, K., Davis, C., Sizer, N., Moore, R., Thau, D., Birch, T., Potapov, P., Turubanova, S., Tyukavina, A., De Souza, N., Pintea, L., Brito, J.C., Llewellyn, O.A., Miller, A.G., Patzelt, A., Ghazanfar, S.A., Timberlake, J., Kloser, H., Shennan-Farpon, Y., Kindt, R., Lilleso, J.P.B., van Breugel, P., Graudal, L., Voge, M., Al-Shammari, K.F. and Saleem, M. (2017). 'An Ecoregion-Based Approach to Protecting Half the Terrestrial Realm'. *BioScience* 67:534-545. DOI: https://doi.org/10.1093/biosci/bix014

Olson, D.M., Dinerstein, E., Wikramanayake, E.D., Burgess, N.D., Powell, G.V., Underwood, E.C., D'amico, J.A., Itoua, I., Strand, H.E., Morrison, J.C. and Loucks, C.J., Allnutt, T.F., Ricketts, T.H., Kura, Y., Lamoreux, J.F., Wettengel, W.W., Hedao, P., and Kassem, K.R. (2001). 'Terrestrial ecoregions of the world: a new map of life on Earth'. *BioScience* 51:933-938. DOI: https://doi.org/10.1641/0006-3568(2001)051[0933:TEOTWA]2.0.CO;2

Spalding, M.D., Agostini, V.N., Rice, J.C. and Grant, S.M. (2012). 'Pelagic provinces of the world: a biogeographic classification of the world's surface pelagic waters'. *Ocean and Coastal Management* 60:19-30. DOI: https://doi.org/10.1016/j.ocecoaman.2011.12.016

Spalding, M.D., Fox, H.E., Allen, G.R., Davidson, N., Ferdaña, Z.A., Finlayson, M.A.X., Halpern, B.S., Jorge, M.A., Lombana, A.L., Lourie, S.A. and Martin, K.D., McManus, E., Molnar, J., Recchia, C.A., and Robertson, J. (2007). 'Marine ecoregions of the world: a bioregionalization of coastal and shelf areas'. *BioScience* 57:573-583. DOI: https://doi.org/10.1641/B570707

TNC (2012). 'Marine Ecoregions and Pelagic Provinces of the World'. GIS layers developed by The Nature Conservancy with multiple partners, combined from Spalding et al. (2007) and Spalding et al. (2012). Available at: http://data.unepwcmc.org/datasets/38

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.

A practical limitation of Marxan is that the maximum number of planning units that can reasonably be included is 50,000 (Ardron et al. 2010). Above that number, results tend to become unreliable. This limitation is not present in prioritizr and analysis is possible with >1 million planning units (Schuster et al. 2019a). Another limitation of Marxan is that analyses take a long time to run. A recent study found that prioritizr generated high quality solutions 1,000 times faster than Marxan for realistic conservation scenarios (Schuster et al. 2019b).

Given the various ways that irreplaceability can be estimated, KBA Proposers should clearly document the method used to enable proper review.

References

Ardron, J.A., Possingham, H.P. and Klein, C.J. (2010). Marxan good practices handbook, Version 2. Victoria, BC: Pacific Marine Analysis and Research Association.

Ball, I.R., Possingham, H.P. and Watts, M. 2009. 'Marxan and relatives: software for spatial conservation prioritisation'. In: Moilanen, A.,Wilson, K.A., and Possingham, H.P. (eds) *Spatial conservation prioritisation: quantitative methods and computational tools.* pp. 185–195. Oxford, UK: Oxford University Press.

Cabeza, M. and Moilanen, A. (2006). 'Replacement cost: A practical measure of site value for cost-effective reserve planning'. *Biological Conservation* 132:336–342. DOI: https://doi.org/10.1016/j.biocon.2006.04.025

Ferrier, S., Pressey, R.L. and Barrett, T.W. (2000). 'A new predictor of the irreplaceability of areas for achieving a conservation goal, its application to real-world planning, and a research agenda for further refinement'. *Biological Conservation* 93:303-325. DOI: https://doi.org/10.1016/S0006-3207(99)00149-4

Hanson, J., Schuster, R., Morrell, N., Strimas-Mackey, M., Watts, M.E., Arcese, P., Bennett, J. and Possingham, H. P. (2017). 'prioritizr: systematic conservation prioritization in *R*'. *R package*.

Pressey, R.L., Johnson, I.R. and Wilson, P.D. (1994). 'Shades of irreplaceability: towards a measure of the contribution of sites to a reservation goal'. *Biodiversity and Conservation* 3:242-262. DOI: https://doi.org/10.1007/BF00055941

Schuster, R., Wilson, S., Rodewald, A.D., Arcese, P., Fink, D., Auer, T. and Bennett, J. R. (2019a). 'Optimizing the conservation of migratory species over their full annual cycle'. *Nature Communications* 10:1-8. DOI: https://doi.org/10.1038/s41467-019-09723-8

Schuster, R., Hanson, J.O., Strimas-Mackey, M. and Bennett, J.R. (2019b). 'Integer linear programming outperforms simulated annealing for solving conservation planning problems'. *bioRxiv* 847632. DOI: https://doi.org/10.1101/847632

Smith, R.J. (2019). 'The CLUZ plugin for QGIS: designing conservation area systems and other ecological networks'. *Research Ideas and Outcomes* 5:e33510. DOI: https://doi.org/10.3897/rio.5.e33510

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 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.[22]

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 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 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

[22] 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 (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 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, namely that the criteria are similar and there is a reliable cross-walk and that documentation standards and review are appropriate. NCGs are responsible for determining whether (iii) is met, namely that 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 defined above, 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 North America 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: 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

VIII.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: www.keybiodiversityareas.org/working-with-kbas/proposing-updating

KBA Partners: www.keybiodiversityareas.org/working-with-kbas/programme

KBA proposal form: www.keybiodiversityareas.org/working-with-kbas/proposing-updating/criteria-tools

KBA Proposal Process guidance: www.keybiodiversityareas.org/working-with-kbas/proposing-updating

KBA Proposer: www.keybiodiversityareas.org/working-with-kbas/proposing-updating

KBA Regional Focal Points: www.keybiodiversityareas.org/working-with-kbas/programme

KBA National Coordination Groups: www.keybiodiversityareas.org/working-with-kbas/programme

KBA Secretariat: www.keybiodiversityareas.org/working-with-kbas/programme

KBA Standards and Appeals Committee: www.keybiodiversityareas.org/working-with-kbas/programme

KBA Technical Working Group: www.keybiodiversityareas.org/working-with-kbas/programme

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

Resolving complex boundary overlaps [in preparation]

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: http://www.keybiodiversityareas.org/kba-data

VIII.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/

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: https://www.iucn.org/sites/dev/files/content/documents/rle_guidelines_draft_dec_2015.pdf

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 Proposed approach to working with Indigenous and local knowledge: http://www.ipbes.net/sites/default/files/downloads/pdf/ipbes-5-4-en.pdf

IUCN Global Ecosystem Typology: https://iucnrle.org/static/media/uploads/references/research-development/keith_etal_iucnglobalecosystemtypology_v1.01.pdf

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/IUCN 2.pdf

IUCN Red List Guidelines: http://cmsdocs.s3.amazonaws.com/RedListGuidelines.pdf

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/about-rle/how-we-work/rle-team/

RLE database: https://assessments.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

Sequence Read Archive: https://www.ncbi.nlm.nih.gov/sra

World Register of Marine Species: http://www.marinespecies.org/

Appendix IX: Summary of changes, clarifications and additions to the KBA Guidelines

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