Guidelines for using the IUCN Environmental Impact Classification for Alien Taxa (EICAT) Categories and Criteria

Version 1.1 (September 2020)

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Contents

1. Introduction

This document provides guidelines for the application of the IUCN Environmental Impact Classification for Alien Taxa (EICAT) Categories and Criteria First Edition. It explains the EICAT assessment process, and provides detailed explanations of the definitions of many of the terms used in the EICAT Criteria. The guidelines should be used in conjunction with the IUCN EICAT Categories and Criteria First Edition. We expect to review and update these guidelines periodically, and input from all users of the IUCN EICAT Categories and Criteria are welcome. We expect that the changes to these guidelines will be mostly additions of detail and not changes in substance. In addition, we do not expect the IUCN EICAT Categories and Criteria to be revised in the near future, because a stable system is necessary to allow comparisons over time.

1.1. Abbreviations

CITES – Convention on International Trade in Endangered Species of Wild Fauna and Flora
COP – Conference of Parties
EICAT – Environmental Impact Classification for Alien Taxa
GISD – Global Invasive Species Database
ISSG – Invasive Species Specialist Group
IUCN – International Union for Conservation of Nature
SPS Agreement – WTO Agreement on the Application of Sanitary and Phytosanitary Measures
WTO – World Trade Organisation

EICAT Categories and Labels:
CG – Cryptogenic
DD – Data Deficient
MC – Minimal Concern
MN – Minor
MO – Moderate
MR – Major
MV – Massive
NA – No Alien Population
NE – Not Evaluated

2. IUCN EICAT process

2.1. Overview of the EICAT process

The EICAT process is managed by the IUCN Species Survival Commission (SSC) Invasive Species Specialist Group (ISSG), alongside the IUCN Global Species Programme. In order to maintain the credibility of EICAT, the process by which taxa can be assessed and included on the IUCN Global Invasive Species Database (GISD) has been formalised. In particular, this process includes the designation of an EICAT Authority under the auspices of the SSC, the responsibilities of which (and whom) are outlined in this document (Section 2.3). These procedures, while clearly essential for implementation of the EICAT process, do not comprise part of the EICAT Categories and Criteria. IUCN will only review and display global EICAT assessments (i.e. assessments of an alien taxon's impacts across its entire alien range, not part thereof), which should be submitted to IUCN following the procedure described in this document.

The basic process for preparing and submitting EICAT assessments to IUCN for publication is summarised below (see also Figure 1).

2.1.1. Pre-assessment

Prior to the assessment phase, raw data from the alien ranges of the taxon being assessed are gathered using an established search protocol (see Section 2.4). Data must be recorded in a format compatible with the EICAT Categories and Criteria and with appropriate supporting documentation (see Section 2.5). Individuals who provide data through the pre-assessment phase, but are not involved in the application of the EICAT Categories and Criteria are termed *Contributors*.

2.1.2. Assessment

All assessments are based on data currently available for alien taxa, compiled in the Pre-assessment step. For each alien taxon, the assessment is performed at two levels:

- assessments of single impact reports
- overall assessment of the alien taxon of interest (i.e. assigning the taxon's global EICAT Category)

More details on these two assessment levels are provided in Section 2.4.

Assessments can be carried out by EICAT Authority members working alone, in small groups, or in large groups for example in a workshop or email/internet forum. Alternatively, other experts can prepare assessments to be submitted to the EICAT Authority, through its Chair, for review. A template has been

developed for Assessors to complete to aid the assessment and review processes (see Appendix 2). All Assessors are required to submit EICAT assessments to the EICAT Authority using this template – until an online database with an end-user interface is developed.

Draft assessments may be made available to the wider community of invasive species experts for additional comment within a defined time period via the ISSG list server. Once a consensus is reached on the taxon's classification by the Assessors, or a majority decision in the case of no consensus being reached, they will be sent for review.

2.1.3. Review

All assessments must go through a review process before they can be accepted for publication on the IUCN GISD. The Chair of the EICAT Authority, or a delegated member of the EICAT Authority, will arrange a review by at least one appropriate expert Reviewer that has not been involved in the assessment as an Assessor. The Reviewer(s) thus appointed will check that the data used have been interpreted correctly and consistently, the EICAT Categories and Criteria have been applied correctly, and that uncertainty has been handled appropriately. The assessments should also be checked to ensure that all essential supporting documentation and any available recommended documentation, is attached and formatted correctly. If an assessment is rejected by the Reviewer, it will be returned to the Assessor(s) detailing the areas that need to be addressed.

2.1.4. Submission

After a satisfactory review, assessments are submitted to the EICAT Unit (via the Chair of the EICAT Authority), which conducts consistency checks to ensure that the EICAT Categories and Criteria have been applied consistently and correctly across all taxa, and that all essential supporting documentation and any available recommended documentation, is attached and formatted correctly.

2.1.5. Publication

Finally, for each alien taxon, its overall classification under the scheme (its global EICAT Category and Criteria), supporting information (including the rationale for the classification and supporting documentation), and the names of the assessors and reviewers will be published on the IUCN GISD.

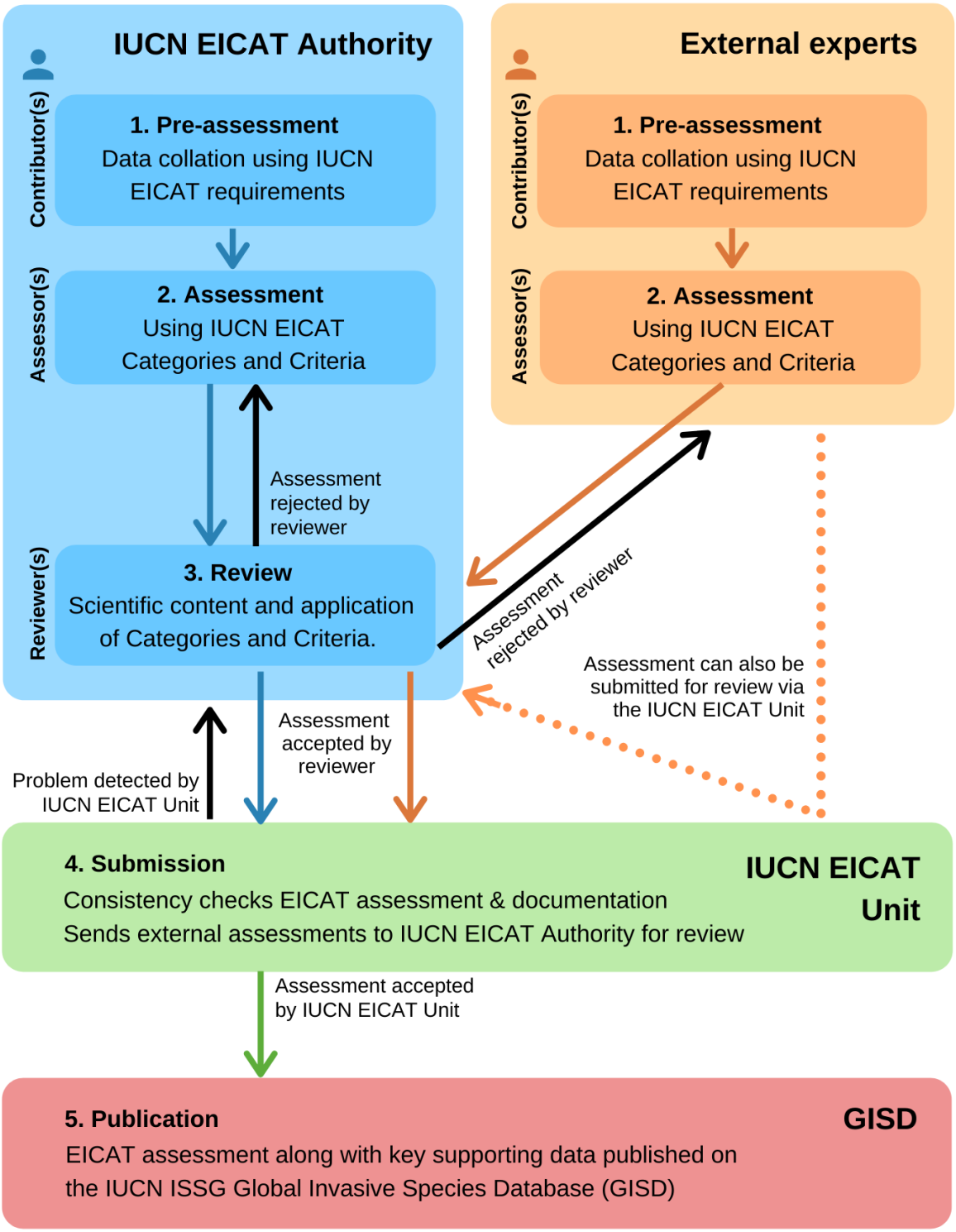


Figure 1. A schematic showing the EICAT process.

2.2. Assessors, Reviewers, and Contributors

Assessors are usually experts on the alien taxon of concern who also have good knowledge of the EICAT Categories and Criteria. Assessors are likely to be members of the EICAT Authority, but they may also be external experts. The Assessor's role in the assessment process is: to use all appropriate data currently available for a taxon with regard to its environmental impacts as an alien; to assess the taxon appropriately; and to determine a confidence rating for the assessment. Assessors ensure that the assessment has the appropriate supporting information as outlined in this document. It is strongly recommended that Assessors are named people (note: there can be more than one Assessor per assessment), but sometimes organisations may be responsible for producing assessments based on data contributed to them (see Contributors below).

Reviewers are people with good knowledge of the EICAT Categories and Criteria. Ideally, Reviewers should also have good knowledge of the taxon being assessed, but sometimes (e.g. through lack of available species experts) this is not possible. Reviewers are people within the EICAT Authority who have not been involved in the assessment process (as an Assessor) for the particular taxon, or may be delegated by the EICAT Authority to external experts. The Reviewer's role in the assessment process is: to read the information presented in the assessment and confirm whether the information has been interpreted appropriately; to check that the EICAT Categories and Criteria have been applied correctly; and to check that confidence levels have been applied appropriately.

Contributors are usually taxon experts or owners of databases containing taxon data. They provide information specifically for use in the taxon account, but they are not directly involved in the actual assessment itself. Reviewers may also have contributed information for the assessment without being directly involved in the assessment. Therefore, a Reviewer may also be named as a Contributor. The purpose of this category is to acknowledge the input of those individuals providing data to an EICAT assessment but not involved in the assessment otherwise. It also enables the acknowledgement of Assessors from a previous EICAT assessment who are not involved in a reassessment.

Box 1. Relationship between Assessors, Contributors, and Reviewers
Yes = The same person can perform both roles for the same assessment
No = The same person cannot perform both roles for the same assessment

	Contributors	***Assessors***	***Reviewers***
Contributors		No	Yes
Assessors	No		No
Reviewers	Yes	No	

2.3. EICAT Authority and EICAT Unit

In summary, the EICAT Unit (once established), will be the administrative body with capacity to processes assessments (see Figure 1). The EICAT Authority is the governing body formed of members of the SSC ISSG and will co-ordinate the overall assessment process.

The Chair of the IUCN SSC ISSG is responsible for establishing or appointing the **EICAT Authority**. The EICAT Authority comprises of individuals who may have remits relating to specific taxonomic groups or geographic regions. The majority of the members of the EICAT Authority will be members of the IUCN Invasive Species Specialist Group, but they may also be members of other SSC specialist groups, independent networks or other organisations. The EICAT Authority is responsible for coordinating the EICAT assessment process, carrying out the majority of assessments, and ensuring that at least one named independent Reviewer (who was not directly involved with the assessment as an Assessor) agrees with the status of each taxon, and that all the documentation to support the assessment is in place.

The EICAT Unit [*will be fully established when funding has been attained*] is formed from selected members of the IUCN Invasive Species Specialist Group and IUCN Global Species Programme. The EICAT Unit checks each assessment to ensure consistency. It will serve as a focal point to receive EICAT assessments undertaken outside of the EICAT Authority, and distribute them for review to appropriate members of the EICAT Authority. It will develop the work-plan, co-ordinate the reporting of status and trends in impacts as documented by the EICAT process, and oversee any proposals for changes or revisions to the EICAT Categories and Criteria, and these guidelines. The EICAT Unit, in consultation with the EICAT Authority, will also develop required policies, for example in relation to the use and application of EICAT, and will manage the petitions process (see below).

The Chair of the EICAT Authority is the overseer and co-ordinator for official IUCN EICAT activities. The Chair acts as the point of contact for the submission of EICAT assessments, and for interactions between the EICAT Authority, EICAT Unit and other IUCN structures, including the IUCN Red List Committee (that oversees the analogous Red List of Threatened Species process), other SSC Specialist Groups, and the office of the Chair of the Species Survival Committee. The Chair is responsible for initiating the consistency checking process, including delegating the process to another member of the EICAT Authority, for EICAT assessments submitted by other members of the EICAT Authority, and for initiating the review process for EICAT assessments submitted from outside the EICAT Authority. The Chair is also responsible for final acceptance of EICAT assessments following the formal review process.

Rules and regulations for membership of the EICAT Authority and EICAT Unit, and for nomination and election of the Chair, will be developed through the IUCN once the mechanisms for the appointment and governance of the EICAT Authorities and EICAT Unit have been developed.

2.4. The Assessment process in more detail

To derive maximum benefit from the EICAT scheme, it must be applied in a consistent and comparable manner across different assessments. The EICAT Categories and Criteria describes the system and provides a framework for the assessment process. Here, further guidelines are provided to:

i) *Clarify elements of the assessment process.*
ii) *Identify the documentation required to support assessments.*
iii) *Demonstrate how to deal with uncertainty in the assessment process.*

2.4.1. Pre-assessment information search protocol

Searches for information to quantify the impacts of alien taxa should preferably be undertaken following an established search protocol. In general, this protocol should follow the process described in Section 4.1 of the Guidelines for Systematic Review and Evidence Synthesis in Environmental Management [1] (here after the Guidelines for Systematic Review). As part of the EICAT assessment, the search protocol should be documented in sufficient detail to enable those reviewing the assessment to replicate the protocol. The search for information should consider both published and unpublished sources (grey literature), and extend to the following:

- Searches of online literature databases and catalogues (as a minimum these databases should include the Web of Science (http://login.webofknowledge.com), Google Scholar (https://scholar.google.co.uk) and Scopus (https://www.scopus.com).
- Searches of the world-wide web (e.g. Google).
- Searches of organisations (as a minimum, including the IUCN Red List of Threatened Species (http://www.iucnredlist.org), Delivering Alien Invasive Species Inventories for Europe (DAISIE) (http://www.europe-aliens.org), the CABI Invasive Species Compendium (http://www.cabi.org/isc/) and the Global Invasive Species Database (GISD) of the Invasive Species Specialist Group (ISSG) (http://www.issg.org/database/welcome/).
- Key texts (for example, for alien birds these may include Lever, C. (2005). Naturalized birds of the world. A&C Black Publishers Ltd. London; and Long, J.L. (1981). Introduced birds of the world. The worldwide history, distribution and influence of birds introduced to new environments. David & Charles. London.)

The literature search should be exhaustive. A review of the bibliographies / references listed in the articles / data sources found through the initial search should be undertaken to identify any additional sources of information. This process should be repeated to a point where no new sources of data are identified.

A search string should be used for effective database searching. The string should include the alien species' scientific and common name, along with relevant terms to identify the impacts of alien species. The following example is a search string to identify impacts associated with the Eurasian blackbird (*Turdus merula*): ("introduced species" OR "invasive species" OR "invasive alien species" OR "IAS" OR "alien" OR "non-native" OR "non-indigenous" OR "invasive bird" OR "pest" OR "feral" OR "exotic") AND ("Eurasian blackbird" OR "blackbird" OR "Turdus merula").

Screening of articles for relevance (and hence inclusion in the EICAT assessment) should be undertaken in accordance with Section 4.2 of the Guidelines for Systematic Review. An initial review of article titles should be undertaken, and for those articles considered relevant based on their title, a review of the abstract should then be undertaken. This process should be recorded for transparency of the decision-making process, as described in Section 4.2.1 of the Guidelines for Systematic Review.

2.4.2. Assessment of individual impact reports

Each relevant impact report gathered during the Pre-Assessment step needs to be assessed using the EICAT Categories and Criteria, and assigned an EICAT Category (Figure 2).

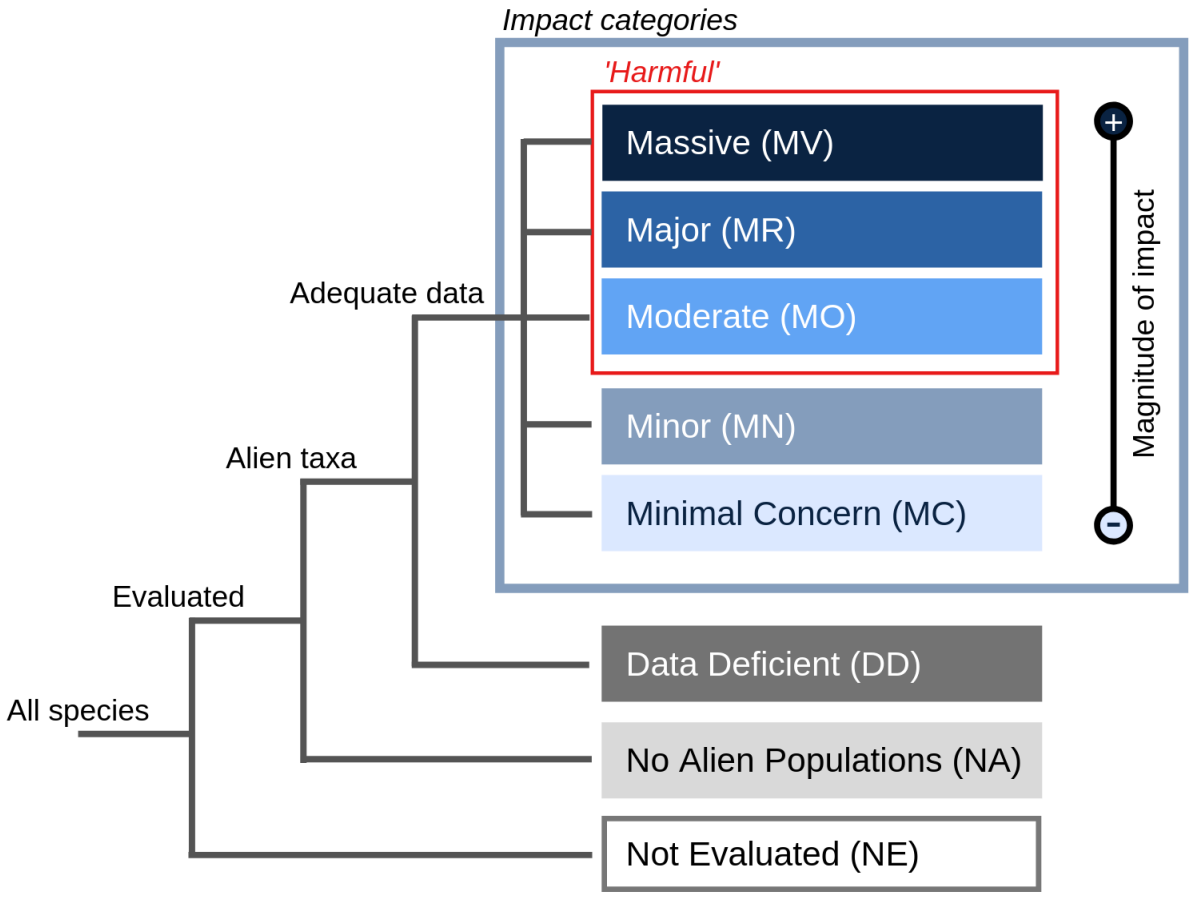


Figure 2. The different EICAT Categories and the relationship between them.

2.4.2.1. Which data sources are relevant for EICAT assessments?

A number of different sources of data may be used as evidence of the impacts of alien taxa on the native biota in EICAT assessments. These data may be held in:

i) *published documents including papers, articles, books and reports.*

ii) *unpublished documents including reports, press articles, grey literature, datasets, databases, GIS data, satellite imagery.*

Data are broadly classified as either observed or inferred:

Observed: Information that is directly based on documented observations of the impacts of an alien population upon native taxa. In this context, the term "observed data" incorporates empirical observations, designed observational studies (natural experiments) and manipulative experiments. Examples include comparison of sites before and after invasions [e.g. 2]; comparison of reference plots

in invaded and uninvaded areas [e.g. 3] or fenced and unfenced plots within the invaded range; and field removal experiments [e.g. 4].

Inferred: Information that is not based on documented observations of the impacts of an alien population that may include assumptions about relationships between an observed variable to the variable of interest. Variables of interest for EICAT assessments are include the performance of individuals (for an impact magnitude **MN**), the number of mature individuals in a population (for **MO**) or its extinction status (for **MR**/**MV**). Sometimes, these variables are not directly observed, but other variables are, from which the variable of interest can be inferred. For example, changes in the number of mature individuals of a native taxon (criterion for **MO**) can be inferred from changes in the number of all individuals (index of abundance); changes in catch statistics; mathematical models; or a decrease in range or an ecosystem function or service provided by the native taxon of interest. Any assumptions should be stated and justified in the documentation. In all these examples, even though they do not directly observe the variables of interest, the observed variables are assumed to be related to the variables of interest for the EICAT assessment (individual performance, number of mature individuals, extinction). Variables not directly related to the variables of interest should not be used to infer impacts. For example, changes in abiotic ecosystem properties (e.g. pH, water availability, etc.) should not be used to assign an impact magnitude unless they have been explicitly shown how they are affecting a native taxon (performance of individuals, the number of mature individuals in a population, or its extinction status).

To be classified in EICAT, changes in the native populations have to be observed or measured in the context in which they are reported: extrapolations or projections in time or space are not considered.
Examples:

- An observed population decline should not be extrapolated to result in a local extinction in the future.
- An impact observed in one location should not be extrapolated to another location where no observations have been done.

Studies that do not allow the detection of any of the five impact magnitudes described in EICAT should not be classified.
Examples:

- Diet/niche overlap between the alien and native populations alone does not show that the performance of native individuals is reduced, or that their populations decline.
- The measure of water quality degradation alone cannot be used to infer an impact on the native fish populations.

- An observed impact on a native plant population cannot be used alone to infer an impact on a native pollinator.

2.4.2.2. Spatial and temporal scales

The spatial and temporal scales over which impact data are recorded can affect interpretation of the severity of impacts caused by an alien taxon, and will affect confidence in the assessment. Studies at restricted spatial scales (e.g. patches of 10s of square metres) might overestimate impacts if extrapolated to larger scales, while studies at extensive spatial scales (i.e. regional or national) might underestimate them. Similarly, studies over time periods that are too short to capture the changes in a native population might over- or underestimate the severity of an impact. In other words, there may be a mismatch between the scale of study and the scale of the impact. For example, an alien taxon might be shown in a field experiment to exclude a native taxon from areas the size of experimental plots, and perhaps even to extirpate the native taxon from entire habitat patches, but at larger spatial scales a part of the local population of the native taxon might still persist (e.g. because of the influence of spatial dynamics, refugia, or rescue effects). In this case, the local population of the native taxon would have declined in the habitats in which the alien taxon occurs, without resulting in a local population extinction. However, impacts demonstrated even at small spatial scales can highlight cause for greater concern in the future, and thus small-scale studies may provide useful evidence of impacts for informing EICAT assessments.

Impacts should ideally be measured at appropriate spatial and temporal scales, taking into account the typical spatial and temporal scale at which the local native population can be characterised. Assessments based on evidence generated at spatial or temporal scales that are very different to the scales over which the local native population can be characterised are likely to be subject to greater uncertainty, due to the challenges involved in extrapolating or down-scaling data to scales relevant to local populations. However, in practise it is difficult to generate a universally applicable definition to describe “the typical spatial scale at which local native populations can be characterised”, as this will depend on the particular native taxon and the location. For example, a local native fish population in a lake may have a clearly defined spatial scale, determined by the size of the lake, whereas it may be much harder to delineate the spatial scale of a particular local native population within a rainforest ecosystem.

2.4.2.3. Additional guidance for key terms

Decline in Population Size

In cases where an alien taxon impacts on recruitment in native taxa, this impact would not count as a reduction in population size (unless there is also an impact on the number of mature individuals); the impact of the alien taxon would be classified as **MN** because it causes a reduction in the performance of native individuals. If and when this decrease in performance leads to a decrease in the resultant number of mature individuals within the native population, the alien taxon would be reclassified as **MO**.

Presumed Extinction

A taxon is presumed to be locally extinct when the impact study tried to find individuals of the local native taxon but no individual was observed, and the study design would have allowed detection of the presence of the native taxon. Local population extinction should be evaluated at the correct spatial scale according to the dynamics of the target native taxon (e.g. a group of individuals spatially disjunct in a metapopulation).

Transmission of disease to native taxa

Due to the nature of the phenomenon of disease transmission, it is often difficult (if not impossible) to observe it happening, nor retrospectively to study where the disease came from. Furthermore, this impact mechanism includes the interaction between two organisms, the alien taxon under assessment, and the disease agent. Where no direct evidence for transmission of the disease from alien taxa to native taxa is available, we suggest that the following evidence is needed in order to classify taxa as **MO** or higher for impact from disease transmission (based on Kumschick et al. 2017 [5]): (1) The disease agent has been shown to be highly devastating to native taxa (see also disease agents in Parasitism, below); (2) the alien taxon is a host of the disease agent in the same time and space as the native population occurs. If these conditions are met at a certain location, no direct evidence for disease transmission is needed. Ideally, we would be interested to know whether the disease agent arrived with the alien, or whether it had an effect on the native community before the alien arrived. However, these aspects cannot be retrospectively assessed and are therefore virtually impossible to study when the invasion has already occurred. Often evidence for the alien taxon being a host of a (more or less devastating) disease is available, and in some cases, spread of the disease with the alien host is studied. In these cases, impacts through transmission of diseases under EICAT should be scored as **MN**. It should in most cases not be scored **MC**, unless the disease or parasite carried by the alien was not found in the native taxa. Furthermore, the impact of the disease itself needs to distinguished from the impact of the host. Separate EICAT assessments need to be performed for the disease agent (identifying if it is alien, and if so, its level of impact) and linked to the assessment of disease transmission of the host – most of these would be captured under the mechanism (5) Parasitism. This can also be important for management, as removing a host from an area might not solve the disease problem itself if the disease agent is already widespread in the native community, or if it is not reliant on the alien host.

Parasitism

Under this mechanism, direct impacts of parasites or pathogens and other disease agents on native taxa need to be noted. This includes the impacts of disease agents transmitted by another alien taxon (see also "Transmission of diseases to native species").

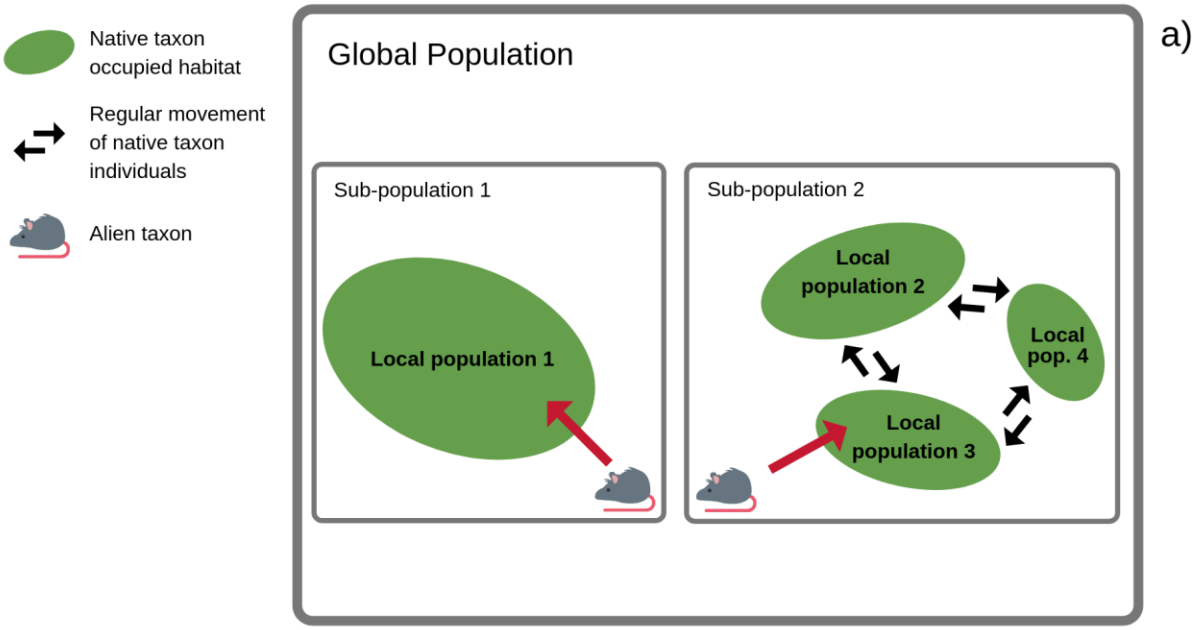
Changes in native community composition

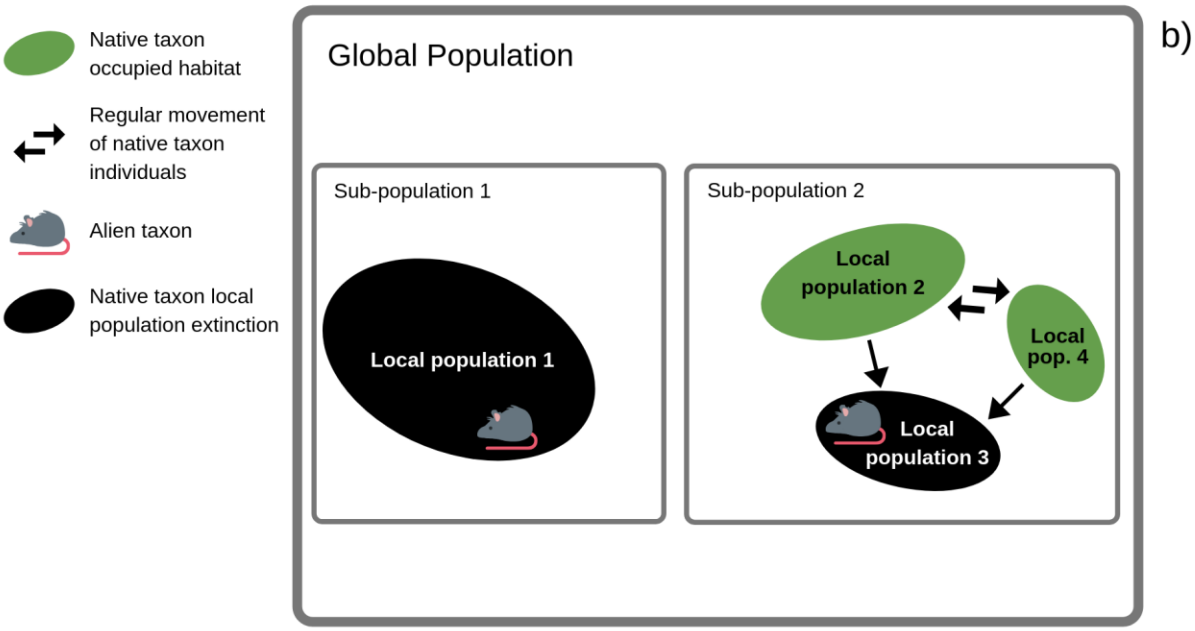
Changes to communities refer to the loss of at least one native taxon in a community (local population extinction of one or more native taxa) due to impacts caused by the alien taxon. Impacts that do not lead to the loss of local populations are not included under this definition, as these are covered by the criterion relating to changes in population size (**MO** impacts), including changes to the species-abundance distribution or other elements of the structure of the community.

Studies describing impacts do not always focus on particular native taxa: they sometimes report a change in the community composition, a decrease in community biomass or a decrease in species richness due to the alien taxon. This information is difficult to translate directly into an EICAT assessment, but the information necessary for an EICAT assessment (which native taxa are impacted and how) can often be extracted from these reports. For example, a decrease in native alpha diversity (local species richness) may indicate a local population extinction, but care must be taken in assessing the sampling effort of the study (e.g. spatial scale, number of replicates), while a change in beta diversity (e.g. species turnover between sites) does not necessarily imply local extinctions or population declines.

Naturally reversible and irreversible changes

The (ir-)reversibility of local extinctions is not only determined by the action of the alien taxon but depends on the context. The feasibility of human assisted measures (eradication of the alien population, re-introduction of the native taxon, or habitat restoration after the degradation due to the alien taxon) is not evaluated when assessing the (ir-)reversibility of a local extinction. Figure 3 provides more guidance on the interpretation of naturally reversible and irreversible changes, and the resulting EICAT Category.


Native taxon occupied habitat
Regular movement of native taxon individuals
Alien taxon
Global Population
Sub-population 1
Local population 1
Sub-population 2
Local population 2
Local pop. 4
Local population 3
a)


Native taxon occupied habitat
Regular movement of native taxon individuals
Alien taxon
Native taxon local population extinction
Global Population
Sub-population 1
Local population 1
Sub-population 2
Local population 2
Local pop. 4
Local population 3
b)

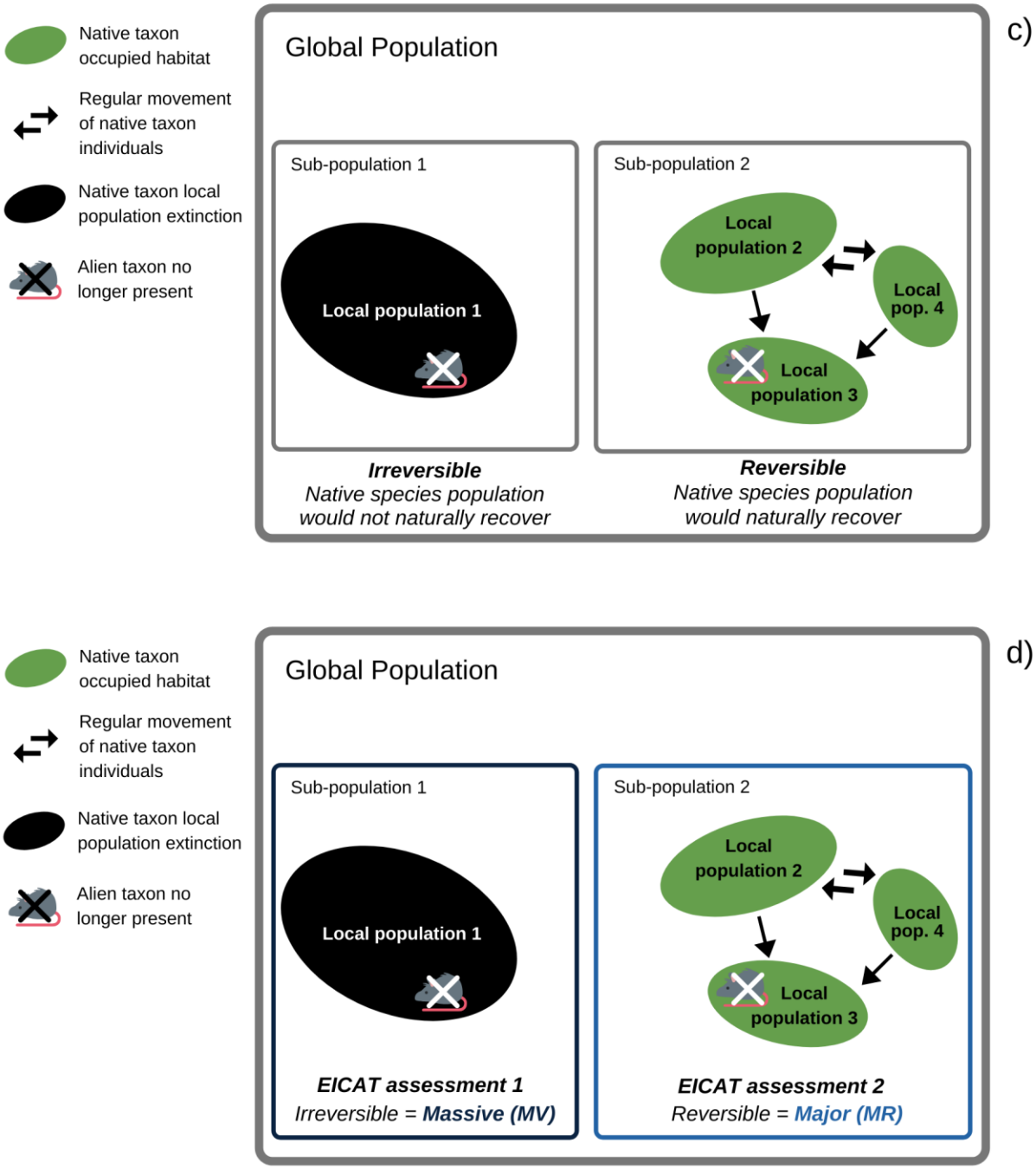


Figure 3. Examples of naturally reversible and naturally irreversible extinctions in the context of EICAT assessments.

The occupied habitat of two local populations of a native taxon (Local Populations 1 and 3) are colonised by an alien taxon (a), and subsequently go locally extinct (local population extinction) (b). If the alien taxon was then no longer present in these areas (for example because of successful eradication of the alien taxon population, or

boom-and-bust dynamics in the alien taxon population), the native taxon would be likely to return to the area previously occupied by Local Population 3 through natural dispersal processes (from Local Population 2 and 4), within three generations or ten years, whichever is longer (c). However, this return would not happen for Local Population 1: the loss of this local population has also resulted in the extinction of Sub-population 1, and given that by definition there is little demographic or genetic exchange between Sub-populations (typically one successful migrant individual or gamete per year or less), the native taxon would not return to this area. Therefore, an EICAT assessment on the impacts of the alien taxon on Local Population 1 would result in categorisation as **MV**, and an assessment of the impacts on Local Population 2 would result in categorisation as **MR** (d).

2.4.2.4. Dealing with uncertainty

There are many cases where uncertainty exists about the correct classification of an impact. Consequently, an estimate of the degree of uncertainty should be attached to all classifications, so that the degree of confidence in every classification is made explicit. Only epistemic or reducible uncertainty (i.e., uncertainty due to data quality) is of importance. Uncertainty related to variation in impacts in space or time (stochasticity or irreducible uncertainty) is not relevant here because only the highest impact reported is considered for assessment purposes.

A number of factors affect the confidence in an assessment, including the reliability and type of data used as evidence of impacts; the spatial and temporal scales over which data were collected; the ease of interpretation of the available data; the chances of including confounding effects in the observation; and whether or not evidence within a single source of information is contradictory.

Data quality and type: In some cases, information about impacts is inferred from observations of variables that are (seemingly) related to the variables of interest in EICAT (individual performance, number of mature individuals, extinction). Inferred data are likely to provide a much lower level of confidence in the assessment. Some studies focus only on one particular level of impact (e.g. the individual performance) not investigating higher levels of impact (e.g. whether the impact on the individual performance is affecting the size of the population). Uncertainty in the assigned Impact Category can exist in such cases since the impact might be higher than the observed and reported one, but the study design and reporting of results does not allow detection of such impacts.

Spatial and temporal scale: Assessors must judge the suitability of the spatial and temporal scales over which evidence of impacts is recorded, for each EICAT assessment. This is used to help determine the confidence rating for the assessment. A full justification for this evaluation should be provided in the rationale for the confidence rating (see below) in the supporting documentation, along with details of

the spatial scale at which impacts have been measured, and how this relates to the spatial scale over which the local native population can be characterised or to the probability of detecting the taxon.
Confounding effects: In most impact reports, it cannot be excluded that other biotic or abiotic factors might have caused or contributed to the observed impact. Therefore, it is difficult to distinguish whether an alien taxon is the driver of environmental changes, or whether confounding effects are at play. The likelihood that the impact level would have been observed if the alien taxon was not introduced must be evaluated by the assessor, based on the context in which the impact is happening (e.g. presence of other stressors which are likely to have led to the observed impact even in the absence of the alien taxon). Confounding effects can lead to an over- or underestimation of the impact caused by an alien taxon.

2.4.2.5. Assigning a confidence score

For each impact report that is relevant for an EICAT assessment, the assessor should place it in the most likely of the five Impact Categories (**MC**, **MN**, **MO**, **MR**, **MV**) and assign a level of confidence to this placement, depending on the likelihood of the assigned Impact Category being correct, based on the reliability of evidence, the type of data used to make the assessment, the spatial scale over which data were recorded, the chances of including confounding effects in the observation, and whether or not the evidence is contradictory (Table 1). Confidence is categorised into three levels: **high**, **medium** and **low,** and can be translated into arbitrary (but indicative) probabilities that the assigned category is correct (Appendix 1).

Table 1: Guidance for confidence classification.

Sources of uncertainty that influence the confidence rating	*Presence of confounding effects*	*Study design*	*Data quality and type*	*Spatial and temporal scale*	*Coherence of evidence*
High confidence: it is likely (approximately 90% chance) that the true Impact Category is equal to the assigned one	The likelihood of including confounding effects is low (i.e. it is unlikely that the level of impact would have been observed if the alien taxon was not introduced)	The study design would have allowed the detection of higher/lower impact magnitudes than the one assigned	There is relevant direct observational evidence to support the assessment; the data are reliable and of good quality	Impacts are recorded at the typical spatial and temporal scales at which the local native population can be characterised	All evidence points in the same direction (no contradictory evidence)
Medium confidence: there is potential for the true Impact Category to be different from the assigned one (approximately 65-75% chance of the assigned impact category being correct)	Confounding effects may be at least partly responsible for the observed impact (i.e. potentially the observed level of impact would still have happened if the alien taxon was not introduced)	The study design would not have allowed the detection of higher/lower impact magnitudes than the one assigned (i.e. it cannot be reasonably excluded)	There is some direct observational evidence to support the assessment, but some of the data are inferred	Impacts are recorded at a spatial or temporal scale which may not be relevant to the scale over which the local native population can be characterised, but extrapolation or downscaling of the data to relevant scales is considered reliable or embraces little uncertainty	Most evidence points in the same direction, but some is contradictory or ambiguous
Low confidence: it is likely that the true Impact Category is different from the assigned one (approximately 35% change of the assigned impact category being correct)	The likelihood of including confounding effects is high (i.e. it is likely that the observed level of impact would have happened if the alien taxon was not introduced)	The study design does not allow any conclusions about higher or lower impact magnitudes and it is likely that the true impact magnitude is higher or lower	There is no direct observational evidence to support the assessment; data are of low quality	Impacts are recorded at a spatial or temporal scale which is unlikely to be relevant to the scale at which the local native population can be characterised, and extrapolation or downscaling of the data to relevant scales is considered unreliable or embraces significant uncertainties	Data are strongly ambiguous, or contradictory

2.4.3 The overall EICAT Category of an alien taxon (Global EICAT assessment)

2.4.3.1. Assigning an EICAT Category to an alien taxon

Each alien taxon is assigned an EICAT Category based on its highest observed impact across all recorded impacts (as described in Section 2.4.2., and see Figure 4). Note that to assign a species to an Impact Category (i.e. from **MC** to **MV**), one impact study is enough as long as it provides the required information (at appropriate temporal and spatial scale etc.).

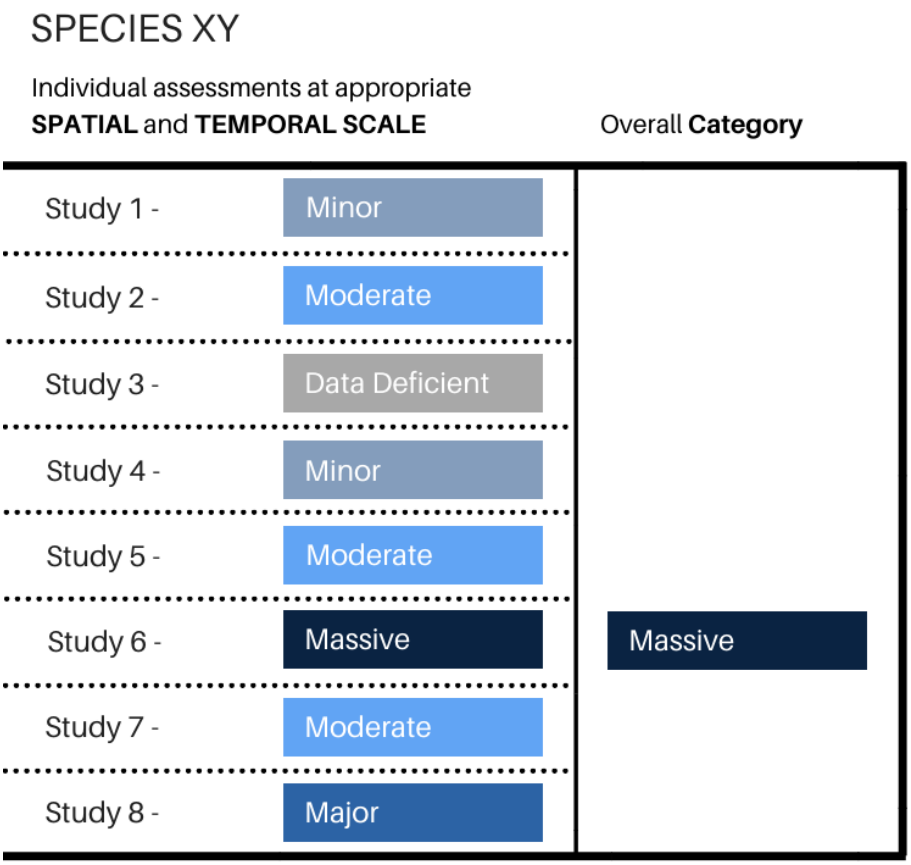


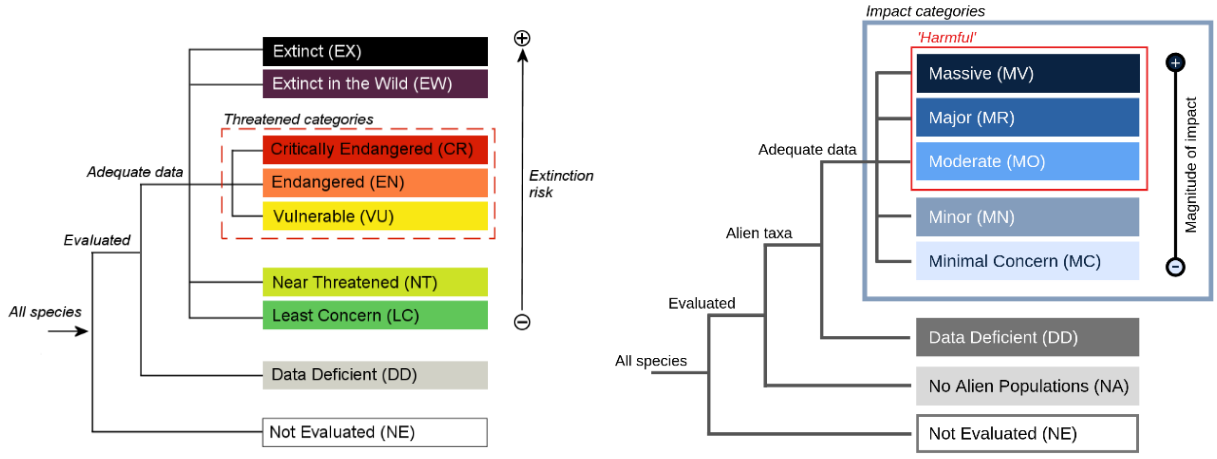
Figure 4. How data from individual EICAT assessments of the impacts of a hypothetical alien taxon (species XY) inform the overall EICAT Category to which the alien taxon is assigned. The overall assessment categorises the taxon based on its highest impact anywhere (in this case, a **Massive** (**MV**) impact).

2.4.3.2. Harmful categories

Alien taxa that are assessed as **Moderate** (**MO**), **Major** (**MR**) or **Massive** (**MV**) are termed 'harmful' (see Figure 2). These are those alien taxa that are currently known to be having the most deleterious impacts upon native biodiversity, leading to population declines (**MO**) and local population extinctions (**MR**, and

MV). However, it is important to note that those categorized as **Minor** (**MN**), and possibly those as **Minimal Concern** (**MC**), are still having deleterious impacts, but not at the level of biological organization of population or communities, and may move to a higher impact category in future assessments if more information becomes available.

The purpose of the 'harmful' tag, is to support in the application of the results of EICAT, for example to aid in communication, or in the prioritisation of alien taxa. The term 'harmful' is used in a similar way to the term 'threatened' is used by the IUCN Red List of Threatened Species™. The term 'threatened' is applied to those species with the greatest risk of extinction (i.e. those assessed as Critically Endangered, Endangered, or Vulnerable) (see Figure 5). This term is used to support application of the results of the IUCN Red List, for example in communication (e.g. 40% of primate species in West and Central Africa are now *threatened* with extinction[1]), or to aid in the prioritisation of species for conservation actions (e.g. the Save our Species fund which funds conservation actions for *threatened* species[2]). The EICAT Category **Minor** (**MN**), is similar in scope to the IUCN Red List Category of Near Threatened which is used for species that are close to qualifying for a 'threatened' category, and IUCN Red List Category of Least Concern, used for widespread and abundant species (though these can have declining populations but not at a rate to qualify for a threatened category or Near Threatened), is similar to the EICAT Category of **Minimal Concern** (**MC**).



[1] IUCN Press Release for the 2019.2 update to the IUCN Red List https://www.iucn.org/news/species/201907/unsustainable-fishing-and-hunting-bushmeat-driving-iconic-species-extinction-iucn-red-list

[2] Save Our Species https://www.saveourspecies.org/

Figure 5 – The IUCN Red List Categories and EICAT Category charts.

2.4.3.3. Confidence at the alien taxon level

The confidence associated with the observation of the highest impact is reported as the overall confidence for the alien taxon. If multiple observations are assigned the same highest Impact Category, the highest confidence of any of them is taken as the overall confidence.

The possibility that higher impacts might have occurred, but were not reported, is not taken into account when evaluating the confidence of the EICAT classification of an alien taxon.

As the spatial extent and timeline of invasions varies widely among taxa, so too will the availability and quality of data on the impacts of aliens. For taxa with well-established and widespread alien populations, there is likely to have been sufficient opportunity to gather data relating to their impacts on native biota. However, for taxa with short alien population residence times, or invasions restricted to small areas, data evidencing impacts on native biota may be limited, or restricted to impacts in one particular area. Irrespective of the invasion history and spatial extent of the invasion, data from the entire area of impact is used to generate a global-level species assessment.

All alien taxa, especially the ones with limited data available on impact, should be re-assessed as and when more direct observational data become available to confirm the classification and improve the confidence rating of the assessment. If there is inadequate or no information to classify an alien taxon with respect to its impact, the taxon should be assessed as **Data Deficient** (**DD**).

2.4.3.4. Lack of evidence of impact

EICAT is applicable to alien populations occurring in any biome, terrestrial, freshwater, and marine. While initially, the impacts within some habitats might be less studied than in others (e.g. see [6] in relation to the marine realm), EICAT criteria are generic and can be applied to any habitat [7] including the marine environment [8]. It is important to stress that a lack of evidence of impacts does not mean there are no impacts. Within EICAT, lack of evidence of impact (categorised as Data Deficient) is treated differently to evidence of lack of impact (categorised as Minimal Concern).

2.5. Supporting documentation

EICAT assessments of any taxon need to be supported by documentation which serves to justify the assessment and to provide relevant information about the taxon and its impacts, which can be used, for example, by regulatory bodies and management practitioners to inform the development of risk assessments and prioritise management actions. There is a minimum level of supporting information that is essential for any assessment, and further recommended documentation that would be useful if the information is available. The **Essential** and **Recommended** documentation for EICAT assessments is outlined below.

2.5.1. Essential documentation

The supporting information detailed below must accompany all EICAT assessments before they can be accepted for publication. The reporting template provided should assist reviewers in this process (see Appendix 2).

2.5.1.1. Documentation relating to the overall EICAT classification of each alien taxon (Global EICAT assessment)

a. Assessor, Contributor, and Reviewer details

- *The names and email addresses (ideally valid for the foreseeable future) of the people or organisations responsible for making the assessment and compiling the supporting information (Assessor(s)).*
- *The names of any other individuals that have provided data, information, comments or helped in some way with the assessment, but who are not responsible for the EICAT assessment itself and/or were not involved in the overall compilation of the assessment (Contributor(s)).*
- *Submission date of the assessment – the final date when all Assessors involved in the assessment agreed on the appropriate EICAT Category for the taxon.*
- *The names and email addresses of the people who have peer reviewed the assessment (and the supporting documentation (Reviewer(s)).*

b. Taxonomy

- *Higher taxonomy details for Kingdom, Phylum, Class, Order and Family.*
- *Scientific name (genus name and species epithet) including authority details. Infra-specific details (e.g., sub-species, variety) must also be provided if relevant.*
- *Common names should be provided, in English, French and Spanish if available.*
- *Common synonyms should be provided.*

- *Taxonomic notes should be included when there are particular problems or issues. Examples include taxa that have undergone recent taxonomic revision or where there are any taxonomic doubts or debates about the validity or identity of the taxon. Taxonomic notes should include synonyms for taxa with commonly used alternative names.*

c. EICAT assessment

- *The country and region of the most severe impact recorded.*
- *The EICAT Category assigned and the Criteria (impact mechanism) met.*
- *A justification (rationale) for the classification, including a detailed explanation to provide evidence for the EICAT Category selected. Further, reasons for any change in classification since previous assessment should be noted, and any numerical data and parameter estimates that underpin the assessment summarised.*
- *If the taxon has been previously assessed, and the Category has changed, select the correct reason for change (see Section 3.).*
- *The confidence rating for the EICAT Category assigned should be stated, including a justification for the level. Uncertainty as to whether a study is in the native range should be recorded, as well as a rationale for the confidence ratings relating to the type, quality, spatial scale and interpretation of data.*

d. Detailed description of impacts

- *A succinct description of all recorded impact Categories and Criteria, including ones of lower magnitude*
- *Native taxa impacted by the alien taxon (provide scientific names as listed on the IUCN Red List of Threatened Species, if they have been assessed).*
- *Pathways of introduction, if known.*
- *Management actions performed on the taxon which (potentially) influenced the impact category.*
- *A description of further research required to clarify or improve data on impact of this taxon.*
- *List of all references with evidence for the EICAT Category assigned.*

2.5.1.2. Documentation pertaining to the assessment of single impact reports

a. All recorded impacts

- *A detailed description of all the impacts recorded for the alien taxon, including the EICAT Categories and Criteria met for each record. This should include a description of where (country and region) and when each impact has been recorded/documented, and the native biota that*

are impacted. Uncertainty as to whether a study is in the native range should be noted. It should also be noted whether these impacts were recorded in the presence or absence of any management actions.

- *A confidence rating for each impact record should be provided, with a justification for the level chosen.*
- *Supporting evidence for each impact listed, including the exact text from the reference supporting the classification (copy and pasted), and the respective reference details.*
- *Observations or data required to improve confidence in the current assessment (e.g. the likelihood of spatial variation in impacts, such that classification may be improved by data from other specified regions).*
- *Information on the likelihood of a classification changing in the near future, with consequences for the urgency of management responses or future assessments, if known.*

b. Management actions

- *A list of management actions in place to manage the spread of the alien taxon, or to remove the taxon from an introduced area (see Appendix 3 for further information).*
- *Further detail about management actions, including the area that is being managed, and the length of time since management action began, if known.*

2.5.2. Recommended documentation

Recommended supporting information is not essential for publication of an EICAT assessment, but its submission is encouraged (see *Appendix 3* for more information on the classification schemes discussed below).

a. Alien range

- *A detailed description of the alien range of the taxon, including dates of introductions where this information is known.*
- *A list of countries of occurrence and sub-country units for large countries and islands far from mainland countries, where the taxon has been introduced outside of its native range.*
- *A list of occurrence in marine regions outside of the native range.*
- *Pathways and vectors of introduction and spread where this information is known.*
- *A GIS map of the alien distribution, preferably shown as polygons (but point occurrences may also be displayed).*

b. Habitat and ecology

- *A summary of the habitat and ecology of the alien taxon.*

- *The major biomes in which the alien taxon occurs (i.e. marine, freshwater, terrestrial).*
- *A list of habitat preferences of the alien taxon.*

c. Native geographic range

- *Detailed description of the native distribution of the taxon.*
- *A GIS map of the distribution of the taxon, preferably shown as polygons (but point occurrences may also be displayed).*
- *A list of countries of occurrence and sub-country units for large countries and islands far from mainland countries.*
- *A list of marine regions in which the taxon occurs.*

d. Alien populations

- *A detailed description of alien populations including information on location, size, trends and spread.*
- *Where relevant, cultivated distribution should be identified separately from naturalised/established or invasive distribution.*

e. Other impacts of the alien taxon

- *Information on the socio-economic impacts of the alien taxon, including beneficial (e.g. human use) as well as deleterious impacts, if known. Note that this information should not contribute to the classification of the alien taxon under EICAT.*

f. Links to images and other sources of information

- *Links to other web sites and databases that may contain further information and images of the alien taxon concerned.*

2.5.3. Sensitive information

Typically, all data supplied in support of an EICAT assessment will be published alongside the assessment on the GISD website. However, in some cases data supplied with an assessment may be sensitive, for example relating to an alien taxon that impacts upon individuals of a threatened species, or upon sites occupied by a threatened species, where publishing those data may have the potential to negatively impact that threatened species. Examples may include the impact of an alien taxon upon economically valuable species or species specifically threatened by trade. In such cases, Assessors may make a case that IUCN withholds the data considered to be sensitive. The EICAT Unit will be responsible for assessing the evidence provided by the Assessors, and assuming that the case can be considered proven, the EICAT Unit will comply with any such request.

3. Reassessment and change in EICAT Category

EICAT assessments for a taxon should be repeated on a regular basis, so that changes in the severity of recorded impacts, or changes in the alien status of taxa that were previously **NA**, can be identified. It is recommended that reassessments should take place at least every five years. Reassessment may result in up-listing to a higher impact category (e.g. from **MO** to **MV** or from **DD** to an impact category), which can take place without delay. Taxa can also be down-listed if the evidence from a previous assessment has erroneously placed a taxon in a higher category, or the information has improved and clarified the impact level. As the overall EICAT Category assigned to a taxon records the maximum observed impact, a taxon cannot be moved into the **NA** category from an impact category, if there are no longer alien populations that exist (e.g. if all alien populations have been eradicated).

Any reassessment of an alien taxon that already has a published IUCN EICAT classification should begin with reference to a copy of the previously published assessment. This can be used as the basis to identify and collate any new published or unpublished information available (either relevant to the taxon in question or relevant contextual information). Data and text fields in the previously published assessment can then be edited and updated on the basis of the new information. The new assessment can then be treated in the same way as any other assessment, with reference to information provided in this document. The citation and authorship for assessments and re-assessments are detailed in Section 4.

3.1. Transfer between Categories

Classification is based on the best available current evidence. Hence, in successive assessments, taxa can move up, and in some cases down Impact Categories as the quality of evidence improves, as environmental or societal conditions change, or as an invasion proceeds. At the most trivial level, we would expect taxa to move, in successive assessments, from **Not Evaluated** (**NE**) into one of the evaluated categories (Figure 2.), or from **No Alien Population** (**NA**) to an alien category (**Data Deficient** (**DD**)**,** or **Minimal Concern** (**MC**), **Minor** (**MN**), **Moderate** (**MO**), **Major** (**MR**), or **Massive** (**MV**)) if introduced into areas beyond natural range limits.

3.2. Maximum recorded impact

An evaluated alien taxon is assigned the EICAT Category according to the maximum recorded impact across all the individual impact assessments made at the appropriate spatial and temporal scale. This Category should remain the same throughout successive assessments unless new evidence suggests that the maximum recorded impact for a particular taxon is higher or lower than previously assessed. For example, if new evidence suggests that the alien taxon is a passenger rather than a driver of change, the EICAT Category assigned to the taxon may be reduced to a lower EICAT Category. Similarly, if new evidence suggests that the taxon has greater impacts than previously known, which cross the threshold for the next impact Category, the EICAT Category assigned to the taxon may be increased to a higher Category. A full justification for any change to the EICAT Category assigned to the taxon should be provided in the assessment documentation.

The following rules govern changes to the EICAT Category assigned to an alien taxon:

A. If the original classification is found to have been erroneous, the taxon may be transferred to the appropriate EICAT Category without delay. In this case, the taxon should be re-evaluated against all the EICAT Criteria to clarify its status.

B. Changes from the **Not Evaluated** (**NE**), **No Alien Population** (**NA**), or **Data Deficient** (**DD**) categories, should be made without delay, if the change is a result of the taxon being evaluated for the first time, becoming introduced for the first time, or due to sufficient information becoming available to categorise the taxon into one of the EICAT Impact Categories for the first time.

C. The reason for a transfer between Categories must be documented as one of the following:

i. **Genuine**. *The change in Category is the result of a genuine status change that has taken place since the previous assessment, due to the taxon being recorded as alien for the first time, or because of a real increase in impact of the taxon where it is alien. Only changes from **NA** into one of the alien Categories (**DD**, **MC**, **MN**, **MO**, **MR**, **MV**), or from a lower to a higher impact Category, can be coded as Genuine.*

ii. **Criteria revision.** *The change in Category is the result of the revision of the EICAT Categories and/or Criteria.*

iii. **New information.** *The change in Category is the result of better knowledge about the taxon, e.g. owing to new or newly synthesised information about the status of the taxon or its impacts, but without a genuine change in the impact level itself. That is, the information suggests that the*

previous categorisation was incorrect, so a new Category is assigned based on this new information.

iv. **Taxonomy**. *The new Category is different from the previous Category owing to a taxonomic change adopted during the period since the previous assessment. Such changes include: newly split (the taxon is newly elevated to the species level), newly described (the taxon is newly described as a species), newly lumped (the taxon is recognised following lumping of two or more previously recognised taxa) and no longer valid/recognised (either the taxon is no longer valid e.g. because it is now considered to be a hybrid or variant, form or subspecies of another species, or the previously recognised taxon differs from a currently recognised one as a result of a split or lump).*

v. **Mistake**. *The previous Category was applied in error because the assessor(s) misunderstood the EICAT Categories and/or Criteria.*

vi. **Incorrect data.** *The previous Category was applied in error because incorrect data were used (e.g. the data referred to a different taxon).*

vii. **Other**. *The change in Category is the result of other reasons not easily covered by the above, and/or requires further explanation.*

Determining the appropriate reason for change will require careful consideration. Category changes may result from a combination of improved knowledge and some element of genuine change in status. In such cases, "Genuine" should only be assigned if the amount of genuine change (e.g., new alien population; impact affecting a new level of organisation) is sufficient on its own to cross the relevant EICAT Category threshold. Genuine and non-genuine reasons for change should never be coded at the same time. All Genuine (recent) or Genuine (since first assessment) Category changes should be supported with appropriate notes to justify why the change is coded as genuine.

4. EICAT Assessment authorship and citation

The *Assessor(s)* are the named authors of an EICAT assessment. The citation for an EICAT assessment is as follows:

> Assessor(s). Year assessment published. *Taxon name.* IUCN Environmental Impact Classification of Alien Taxa (EICAT). http://www.iucngisd.org/gisd/...[URL to species page on the IUCN Global Invasive Species Database].

Reassessment

When a taxon is reassessed the *Assessor(s)* should make every reasonable effort to contact the assessors of the previous assessment to ask if they would like to engage in the reassessment process. If they engage in the assessment process, both the previous and new *Assessors* are named as joint *Assessors* in the reassessment. If the original assessors are unable to engage, cannot be contacted, or only provide additional data and do not want to take part in the reassessment of taxa's EICAT Impact Category, they are automatically named as a *Contributor* and not as a joint *Assessor*.

5. Petitions process

Accepted and published IUCN EICAT assessments are open to challenge, in the case that a party has good reason to disagree with the Category or Criteria assigned to a taxon. Petitions may only be made on scientific or technical grounds on the basis of the EICAT Categories and Criteria, or in reference to any supporting documentation accompanying the assessment. Challenges based on political, emotional, economic, or other reasons not based on the EICAT Categories and Criteria or supporting documentation will not be considered. Any party may contact the EICAT Unit at any time to express disagreement. If this disagreement is based on scientific or technical grounds, the EICAT Unit will put this party in contact with the relevant Assessor(s) with intention of resolving the disagreement. In the event of a disagreement concerning the classification of a taxon that is in the process of being reassessed, the EICAT Unit will seek to involve the party expressing disagreement in the reassessment process, with the objective of reaching consensus on the new classification.

If these processes are not successful in resolving the disagreement, a formal petition may be submitted by the challenger. A formal petition should provide a brief summary of the points of disagreement, with explicit reference to the EICAT Categories and Criteria under which the taxon is listed (2 pages maximum). During the petitions process, all parties should acknowledge receipt of all correspondence as soon as possible, so that any failure in delivery is detected as early as possible. All correspondence should be treated as confidential. The steps for filling petitions are as follows:

1. Petitions can be submitted to the EICAT Unit at any time. The EICAT Unit will acknowledge receipt of the petition, and will inform the petitioner of the date on which the petition was received.
2. The EICAT Unit will consult with members of the EICAT Authority to determine whether or not the petition has been filed on the basis of the EICAT Categories and Criteria. If the petition has not been made on this basis, it will be returned to the petitioner by the EICAT Unit with an explanation as to why the petition cannot be considered.
3. If the petition is made on the basis of the EICAT Categories and Criteria, it will be referred by the EICAT Unit to the particular Assessor/s responsible for the taxon assessment in question. The EICAT Unit will request the Assessor and the petitioner to discuss the petition with the objective of reaching an agreement between them. In seeking to reach agreement, the Assessor and the petitioner should: (i) determine whether or not they are using the same underlying data; and (ii) clarify whether or not the disagreements are due to factual discrepancies, as opposed to differences of either interpretation or application of the EICAT Categories and Criteria.

4. If the Assessor and the petitioner come to agreement, then any changes to the listing will be accepted, and the published EICAT assessment will be amended accordingly.

5. If the Assessor and the petitioner are unable to agree within 4 months of first contact, then the EICAT Unit will notify both the petitioner and the Assessor that each should submit justifications for their case to the EICAT Unit, within the next two months. Justifications should be no more than 4 sides of A4 (12 point font, 1.5 spaced), and should include a synopsis of the failed negotiations, a brief statement of the reasons for the dispute, and a clarification of any factual discrepancies (e.g. different sources of data or information used). All data used in these justifications must either be referenced to publications that are available in the public domain, or else be made available to the EICAT Unit. The data provided should be clearly linked to the use of the EICAT Categories and Criteria. If the petitioner fails to submit a justification within the set time period and in the required format, the petition will be dropped. If the Assessor fails to submit a justification within the set time period, the petition will go forward.

6. The EICAT Unit will send the justifications of each party to the other within one week of the time period set above, or within one week of both justifications having been received. Both parties have three weeks in which to provide a 1-page addendum to their justifications, should they choose to do so. Any addendums received after the three- week period will not be considered. The parties may not make any changes to the original justifications.

7. At the end of this three-week period, whether or not an addendum is received, three members of the EICAT Authority (typically members of the ISSG) will be selected to review the case, on the basis of their relevant expertise. These EICAT Authority members may choose to circulate the justifications to other independent expert reviewers for confidential comments. If needed, the EICAT Unit may seek clarification of particular issues from the Assessor and the petitioner. In instances in which the Assessor failed to submit a justification, the EICAT Unit will make every effort to obtain a balanced set of confidential comments from reviewers.

8. The selected EICAT Authority members will make a ruling on each petition within three months from the time that the petitions were circulated to the three members by the EICAT Unit. The EICAT Unit will issue a notification that will include a full rationale and explanation of each ruling, but will not include a record of the deliberations that the EICAT Authority members made to reach the decision, and the names of any reviewers will be kept confidential. The EICAT Unit will send this notification to the petitioner and to the Assessor. Any changes to the category will be made to the published EICAT assessment. The notification of the ruling on any petition, and any resulting change in category, will be placed on the GISD website.

9. If there is an assertion that the above procedure has been violated, then a formal and documented complaint may be submitted to the Chair of the SSC ISSG.

6. Future documents

IUCN SSC ISSG are planning to produce a number of additional documents to support the application of EICAT and its appropriate use, this includes:

6.1. Appropriate uses for EICAT assessments.

This will address issues on how the results of EICAT should be used, and identify potential misuse of the outputs of EICAT assessments. A similar has been provided for the IUCN Red List. However, it is important to stress that EICAT assessment results should not be used on their own to prioritise invasive alien species (or habitats) for management measures, as additional information is needed (e.g. see [9, 10, 11]).

6.2. Case studies.

Case studies/examples of EICAT assessments will be made available to support the application of the EICAT, as more taxonomic groups are assessed.

6.3. Data management plan.

A detailed data management plan will be developed as a separate document to detail how EICAT assessment information will be handled by IUCN.

7. References

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Appendix 1: Estimating the distribution of uncertainty

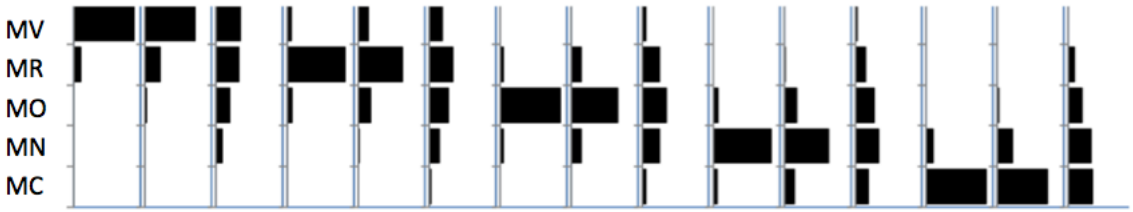
Uncertainty in assessment classifications means that there is some probability that an alien taxon should in reality be assigned to another category (most likely to a neighbouring category; Figure 2.). This probability will be lowest for taxa categorised with High confidence, and highest for taxa categorised with Low confidence. It is possible to estimate the distribution of this probability in each case, by assigning it on the basis of a range of theoretical probability distributions.

Table S1 presents an example of this approach. Confidence levels are translated into probabilities that the assigned category is the correct one. In this example, High confidence means that the assessor feels they have approximately a 90% chance of the given score being correct; Medium confidence, a 65-75% chance of being correct; Low confidence, a 35% chance of being correct. The remaining probability has been assigned to the other categories according to a beta probability density function [12]. The Beta distribution is a continuous distribution on the range [0, 1]. It is defined by two positive parameters, α, β, that control the shape of the distribution. The range [0, 1] was discretised by dividing it into 5 equally-sized intervals, representing the 5 impact categories. We calculated the values of the beta probability density function at the mid-point of each interval, with parameters chosen such that the assigned category had the highest probability and the variance in confidence increased from High to Medium to Low, taking approximate values of 0.007, 0.011, and 0.038, respectively. Values of the beta distribution were standardised such that the 5 values sum up to 1. The table shows that a classification of **MV** with High confidence still has some probability of being incorrect, and that the most likely alternative classification is **MR**; likewise, a classification of **MO** with Low confidence has a relatively high probability of being incorrect, and the correct classification may be any of the other categories (albeit that neighbouring categories in Figure 2 are still the most likely alternatives). These distributions of likelihoods, together with the descriptions of uncertainties in Table S1, may serve as guidance for assessors to assign confidence levels to their assessments. A choice of predefined distributions offers a consistent way to infer a rating distribution from a single confidence rating, but we suggest that assessors examine these distributions carefully to make sure they accord with their own perception of confidence.

Table S1. Suggested distribution of likelihoods (in percent) of the impact of alien taxa being in a certain category depending on the confidence of the assessment.

Probability distributions follow a beta probability density function with parameters α and β, as implemented in Excel. The histogram below the table provides a pictorial representation of the same probabilities.

Category	MV			MR			MO			MN			MC		
Confidence	High	Med	Low	High	Med	Low	High	Med	Low	High	Med	Low	High	Med	Low
Distribution of Likelihoods (%)															
MV	90	75	36	6	15	19	0	0	6	0	0	2	0	0	0
MR	10	23	34	87	66	35	5	15	26	0	1	15	0	0	9
MO	0	2	21	7	18	29	90	70	36	7	18	29	0	2	21
MN	0	0	9	0	1	15	5	15	26	87	66	35	10	23	34
MC	0	0	0	0	0	2	0	0	6	6	15	19	90	75	36
α/β	3/18	2/10	1.4/3	7.3/18	4.4/10	1.8/3	18/18	10/10	3/3	18/7.3	10/4.4	3/1.8	18/3	10/2	3/1.4



Appendix 2: Data reporting template

Please see separate excel spreadsheet “EICAT Data reporting template v 3.3”.

Appendix 3: Additional classification schemes

i. Distribution information

The EICAT scheme has adopted the same distribution recording system as used in the IUCN Red List of Threatened Species. Distribution is recorded in terms of country names following the 5th edition (and subsequent web updates) of the ISO-3166-1 standard [13]. For large countries (e.g. Australia, Brazil, China, India, South Africa, the Russian Federation and the United States of America) or countries spanning diverse biogeographic regions (e.g. Colombia, Ethiopia, Pakistan), distributions within the country should also be listed, using the standard set of Basic Recording Units (BRU) provided by the International Working Group World Geographical Scheme for Recording Plant Distributions (TDWG). These Basic Recording Units (BRU) are sub-country units based on provinces or states. Unless geographically very remote from each other, islands and other territories are included with the parent country. In the case of taxa that inhabit islands significantly distant from the mainland, the island name is given in parentheses (e.g. Spain (Canary Islands)). The naming of such islands follows Brummitt (2001) [14], prepared for the TDWG.

For marine taxa, country records should be provided wherever possible. This information can be derived from a number of sources (e.g. FishBase and the many FAO publications). For some marine taxa, particularly those with ranges outside of territorial waters, distributions should also be shown as generalised ranges in terms of the FAO Fishing Areas.

ii. Habitats classification scheme

The EICAT scheme has adopted the same habitat nomenclature as used in the IUCN Red List of Threatened Species [15]. The habitat types listed below are standard terms used to describe the major habitat(s) in which taxa occur.

The three levels of the hierarchy are self-explanatory, as they use familiar habitat terms that take into account biogeography, latitudinal zonation, and depth in marine systems. The inland aquatic habitats are based primarily on the classification system of wetland types used by the Ramsar Convention (see Ramsar Wetland Type Classification System). Further details about applying the habitats classification scheme, including a brief description of each habitat, can be found here.

1 Forest

1.1 Boreal Forest

1.2 Subarctic Forest

1.3 Subantarctic Forest

1.4 Temperate Forest

1.5 Subtropical/Tropical Dry Forest

1.6 Subtropical/Tropical Moist Lowland Forest

1.7 Subtropical/Tropical Mangrove Forest Vegetation Above High Tide Level

1.8 Subtropical/Tropical Swamp Forest

1.9 Subtropical/Tropical Moist Montane Forest

2 Savanna

2.1 Dry Savanna

2.2 Moist Savanna

3 Shrubland

3.1 Subarctic Shrubland

3.2 Subantarctic Shrubland

3.3 Boreal Shrubland

3.4 Temperate Shrubland

3.5 Subtropical/Tropical Dry Shrubland

3.6 Subtropical/Tropical Moist Shrubland

3.7 Subtropical/Tropical High Altitude Shrubland

3.8 Mediterranean-type Shrubby Vegetation

4 Grassland

4.1 Tundra

4.2 Subarctic Grassland

4.3 Subantarctic Grassland

4.4 Temperate Grassland

4.5 Subtropical/Tropical Dry Lowland Grassland

4.6 Subtropical/Tropical Seasonally Wet/Flooded Lowland Grassland

4.7 Subtropical/Tropical High Altitude Grassland

5 Wetlands (inland)

5.1 Permanent Rivers, Streams, Creeks [includes waterfalls]

5.2 Seasonal/Intermittent/Irregular Rivers, Streams, Creeks

5.3 Shrub Dominated Wetlands

5.4 Bogs, Marshes, Swamps, Fens, Peatlands [generally over 8 ha]

5.5 Permanent Freshwater Lakes [over 8 ha]

5.6 Seasonal/Intermittent Freshwater Lakes [over 8 ha]

5.7 Permanent Freshwater Marshes/Pools [under 8 ha]

5.8 Seasonal/Intermittent Freshwater Marshes/Pools [under 8 ha]

5.9 Freshwater Springs and Oases

5.10 Tundra Wetlands [includes pools and temporary waters from snowmelt]

5.11 Alpine Wetlands [includes temporary waters from snowmelt]

5.12 Geothermal Wetlands

5.13 Permanent Inland Deltas

5.14 Permanent Saline, Brackish or Alkaline Lakes

5.15 Seasonal/Intermittent Saline, Brackish or Alkaline Lakes and Flats

5.16 Permanent Saline, Brackish or Alkaline Marshes/Pools

5.17 Seasonal/Intermittent Saline, Brackish or Alkaline Marshes/Pools

5.18 Karst and Other Subterranean Inland Aquatic Systems

6 Rocky Areas [e.g. inland cliffs, mountain peaks]

7 Caves and Subterranean Habitats (non-aquatic)

7.1 Caves

7.2 Other Subterranean Habitat

8 Desert

8.1 Hot

8.2 Temperate

8.3 Cold

9 Marine Neritic (Submergent Nearshore Continental Shelf or Oceanic Island)

9.1 Pelagic

9.2 Subtidal Rock and Rocky Reefs

9.3 Subtidal Loose Rock/Pebble/Gravel

9.4 Subtidal Sandy

9.5 Subtidal Sandy-Mud

9.6 Subtidal Muddy

9.7 Macroalgal/Kelp

9.8 Coral Reef

9.8.1 Outer Reef Channel

9.8.2 Back Slope

9.8.3 Foreslope (Outer Reef Slope)

9.8.4 Lagoon

9.8.5 Inter-Reef Soft Substrate

9.8.6 Inter-Reef Rubble Substrate

9.9 Seagrass (Submerged)

9.10 Estuaries

10 Marine Oceanic

10.1 Epipelagic (0–200 m)

10.2 Mesopelagic (200–1,000 m)

10.3 Bathypelagic (1,000–4,000 m)

10.4 Abyssopelagic (4,000–6,000 m)

11 Marine Deep Ocean Floor (Benthic and Demersal)

11.1 Continental Slope/Bathyl Zone (200–4,000 m)

11.1.1 Hard Substrate

11.1.2 Soft Substrate

11.2 Abyssal Plain (4,000–6,000 m)

11.3 Abyssal Mountain/Hills (4,000–6,000 m)

11.4 Hadal/Deep Sea Trench (>6,000 m)

11.5 Seamount

11.6 Deep Sea Vents (Rifts/Seeps)

12 Marine Intertidal

12.1 Rocky Shoreline

12.2 Sandy Shoreline and/or Beaches, Sand Bars, Spits, etc.

12.3 Shingle and/or Pebble Shoreline and/or Beaches

12.4 Mud Shoreline and Intertidal Mud Flats

12.5 Salt Marshes (Emergent Grasses)

12.6 Tidepools

12.7 Mangrove Submerged Roots

13 Marine Coastal/Supratidal

13.1 Sea Cliffs and Rocky Offshore Islands

13.2 Coastal Caves/Karst

13.3 Coastal Sand Dunes

13.4 Coastal Brackish/Saline Lagoons/Marine Lakes

13.5 Coastal Freshwater Lakes

14 Artificial - Terrestrial

14.1 Arable Land

14.2 Pastureland

14.3 Plantations

14.4 Rural Gardens

14.5 Urban Areas

14.6 Subtropical/Tropical Heavily Degraded Former Forest

15 Artificial - Aquatic

15.1 Water Storage Areas [over 8 ha]

15.2 Ponds [below 8 ha]

15.3 Aquaculture Ponds

15.4 Salt Exploitation Sites

15.5 Excavations (open)

15.6 Wastewater Treatment Areas

15.7 Irrigated Land [includes irrigation channels]

15.8 Seasonally Flooded Agricultural Land

15.9 Canals and Drainage Channels, Ditches

15.10 Karst and Other Subterranean Hydrological Systems [human-made]

15.11 Marine Anthropogenic Structures

15.12 Mariculture Cages

15.13 Mari/Brackish-culture Ponds

16 Introduced Vegetation

17 Other

18 Unknown

iii. Management action classification

Any management actions in place to eradicate or control an alien taxon, or mitigate its impacts on native taxa, should be classified based on the scheme below, developed for the Global Invasive Species Database (GISD). Actions are broadly classified according to their ultimate aim (monitoring, prevention, control or eradication; Table 3) and then based on the methods used (Tables 4 – 6). A number of different methods are often used together, and where this is the case, all active management actions should be listed. The area covered by the management actions should also be indicated so that impacts can be understood in the context of these actions.

Table S2. Codes, names and definitions of different management actions for alien taxa.

Management CATEGORY CODE	Management CATEGORY NAME	Definition
6	Monitoring	Measures taken to evaluate the distribution, expansion and/or density of the alien taxon.
1	Prevention	Measures taken to stop the taxon from entering an area.
2	Eradication	Actions taken to eliminate all occurrences of a taxon. Long term, on-going eradication projects are included in this category.
3	Control	Measures taken to reduce a taxon or biomass (control), to keep a taxon in a defined area (containment), and/or to reduce harmful effects of a taxon (mitigation).
4	None	
5	Unknown	

Table S3. Codes and names of management actions aiming to prevent alien taxa from entering an area.

Prevention Method CODE	Prevention Method NAME
1	Risk assessment
2	Legal Status (restrictions)
3	Best practises
4	Cultural methods

Table S4. Codes and names of management actions designed to control populations of alien taxa established in an area.

Control Method CODE	Control Method NAME
1	Physical-Mechanical (manual)
2	Chemical
3	Biological
4	Integrated methods
99	Unknown

Table S5. Codes and names of management actions aiming to eradicate populations of alien taxa from an area in which they are established.

Eradication Method CODE	Eradication Method NAME
1	Shooting
2	Trapping
3	Hand removal
4	Pesticides or herbicides
5	Poisoning or toxicants
6	Others (disease, fumigants, draining...)
99	Unknown