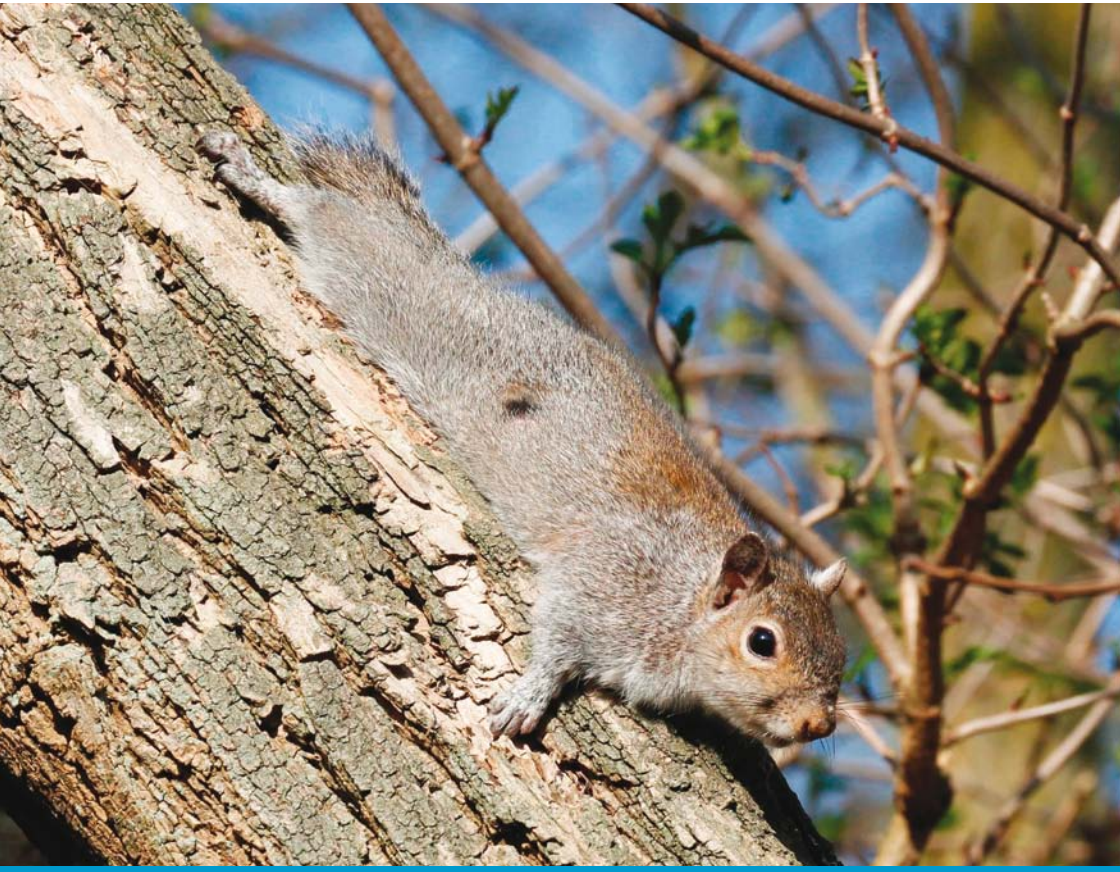
IUCN EICAT Categories and Criteria

The Environmental Impact Classification for Alien Taxa (EICAT)

First edition



INTERNATIONAL UNION FOR CONSERVATION OF NATURE

SSC Species Survival Commission

ISSG Invasive Species Specialist Group

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The Environmental Impact Classification for Alien Taxa

First edition

Prepared by the IUCN Species Survival Commission (SSC)
As approved by the
98th meeting of the IUCN Council
Gland, Switzerland
10-11/02/2020

Published by: IUCN, Gland, Switzerland and Cambridge, UK

Citation: IUCN (2020). *IUCN EICAT Categories and Criteria. The Environmental Impact Classification for Alien Taxa* First edition. Gland, Switzerland and Cambridge, UK: IUCN. X + Xpp.

Layout by: www.naturebureau.co.uk

ISBN: 978-2-8317-2040-1 (PDF)
ISBN: 978-2-8317-2041-8 (print)
DOI: https://doi.org/10.2305/IUCN.CH.2020.05.en

Printed by: www.langhampress.co.uk
The text of this book is printed on 115gsm FSC Silk

Cover Photo: Grey Squirrel, *Sciurus carolinensis* © Tim Blackburn

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About this publication

This document has been adapted from:

Hawkins *et al*. 2015. 'Framework and guidelines for implementing the proposed IUCN Environmental Impact Classification for Alien Taxa (EICAT)'. *Diversity and Distributions,* 21(11): 1360-1363 https://doi.org/10.1111/ddi.12379

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Preface

The IUCN Species Survival Commission (SSC) Invasive Species Specialist Group (ISSG) were invited by Parties to the Convention on Biological Diversity (CBD) to develop a '*system for classifying invasive alien species based on the nature and magnitude of their impacts'* (CBD, 2014). In 2015, the ISSG published a *framework and guidelines for implementing the proposed IUCN Environmental Impact Classification for Alien Taxa (EICAT)* (Hawkins et al., 2015) developed from the original framework proposed by Blackburn et al. (2014).

Following the publication of Hawkins et al. (2015), Resolution WCC-2016-Res-018-EN *Toward an IUCN standard classification of the impact of invasive alien species* was adopted at the 2016 IUCN World Conservation Congress. This Resolution requested the SSC to develop EICAT, and to consult with all relevant stakeholders within the Union to inform this process. It also requested that the SSC integrate the outcomes into the IUCN Global Invasive Species Database and the IUCN Red List of Threatened Species, thus providing an essential background for the achievement of Aichi Target 9 (and subsequent related targets) and SDG Target 15.8. Additionally the Resolution requested IUCN Council to adopt the framework for the IUCN Environmental Impact Classification for Alien Taxa, once the consultation process referred to above had been completed, as the Union's standard for classifying alien species in terms of their environmental impact.

In 2017, IUCN undertook a Union-wide consultation on the science underpinning EICAT (Version 1), its processes and governance. The results showed that the Union overwhelmingly supported EICAT becoming an IUCN Standard for classifying alien taxa against the magnitude of their environmental impacts. However, based on feedback received through this consultation process and lessons learnt through its application, significant edits were made to the proposed standard. In 2019, a second Union-wide consultation was undertaken on the *EICAT Categories and Criteria* (Version 2.3), *Guidelines for the application of EICAT* (Version 2.3), and the *EICAT data reporting template* (Version 2.7): the comments received during this consultation resulted in minor edits being made to the documentation. Following this, the IUCN Council (98th Meeting, February 2020), adopted Version 3.3. of the EICAT Categories and Criteria as the Union's Standard for classifying alien species in terms of their environmental impact.

This document presents the IUCN Standard for classifying alien species in terms of their environmental impact; the *IUCN Environmental Impact Classification for Alien Taxa (EICAT) Categories and Criteria: First edition* (the same as Version 3.3 adopted by IUCN Council).

To ensure full understanding of the application of EICAT, it is very important to refer to all of the following documents:
(1) *IUCN Environmental Impact Classification for Alien Taxa (EICAT) Categories and Criteria: First edition* (IUCN, 2020) – this document.
(2) The latest version of the 'Guidelines for using the IUCN EICAT Categories and Criteria' (check the IUCN ISSG website http://issg.org/ for regular updates of this document)
All of the above documents are freely available to download from the IUCN ISSG (http://www.issg.org).

The intention is to keep the EICAT Categories and Criteria (the IUCN Standard) consistent to enable genuine changes in the magnitude of environmental impacts of alien species to be detected. As a greater clarity emerges on tricky and unresolved issues, these will be addressed through updates to the comprehensive set of user guidelines.

Blackburn et al. (2014). 'A unified classification of alien species based on the magnitude of their environmental impacts'. *PLoS Biology*, 12, e1001850. https://doi.org/10.1371/journal.pbio.1001850

CBD (2014). Decision adopted by the Conference of the Parties to the Convention on Biological Diversity XII/17. Invasive alien species: review of work and considerations for future work. https://www.cbd.int/decision/cop/default.shtml?id=13380

Hawkins et al. (2015). 'Framework and guidelines for implementing the proposed IUCN Environmental Impact Classification for Alien Taxa (EICAT)'. *Diversity and Distributions,* 21(11) https://doi.org/10.1111/ddi.12379

Acknowledgements

IUCN gratefully acknowledges the dedication and efforts of the IUCN SSC and IUCN Secretariat Members, and other experts involved in the EICAT criteria review in attending numerous workshops to discuss and debate the merits and demerits of the EICAT Categories and Criteria. In addition, IUCN would like to thank all those who took part in both rounds of the IUCN-wide EICAT consultation, in which we received invaluable feedback and insightful suggestions.

Particular thanks must go to Kevin Smith who chaired the review and steered an extremely complex process through to a successful conclusion. This review culminated in the adoption of the EICAT Categories and Criteria by the IUCN Council.

Abbreviations

CBD – Convention on Biological Diversity
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
SSC – Species Survival Commission

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

1. Introduction

Human activities are transforming natural environments by moving taxa beyond the limits of their native geographic ranges into areas where they do not naturally occur. Many of these alien taxa have had substantial adverse impacts on the recipient ecosystems. For example, they have been shown to cause significant changes in native species extinction probabilities, genetic composition of native populations, behaviour patterns, taxonomic, functional and phylogenetic diversity, trophic networks, ecosystem productivity, nutrient cycling, hydrology, habitat structure, and various components of disturbance regimes [1-8]. For these reasons, most governments, scientists and conservation organisations consider many alien taxa to be undesirable additions to ecosystems, and frequently devote considerable resources towards preventing or mitigating their impacts. The magnitude and type of impacts generated by alien taxa vary greatly among recipient ecosystems, and many of these impacts only become obvious or influential long after the onset of invasion. Moreover, many impacts remain or are difficult to redress even if the alien taxa of concern are removed or controlled. As such, there is a critical need for scientifically robust tools to evaluate, compare, and predict the magnitudes of the impacts of different alien taxa, in order to determine and prioritise appropriate actions where necessary [9].

A unified classification of alien taxa based on the magnitude of their environmental impacts [10] (hereafter referred to as the Environmental Impact Classification for Alien Taxa, abbreviated to EICAT) has been developed in response to these issues. EICAT is a simple, objective and transparent method for classifying alien taxa in terms of the magnitude of their detrimental environmental impacts in recipient areas. Based on evidence on the impacts they have been causing on native taxa in their introduced range, alien taxa are classified into one of five impact categories. Each of these five impact categories represents a different impact magnitude, depending on the level of biological organisation of the native biota impacted (individual, population or community) and the reversibility of this impact. Alien taxa are also classified according to the mechanisms by which these impacts occur: the mechanisms are aligned with those identified in the IUCN Global Invasive Species Database (GISD) http://www.iucngisd.org/gisd/.

EICAT has the following five objectives: (i) identify alien taxa by levels of environmental impact, (ii) compare the level of impact by alien taxa among regions and taxonomic groups, (iii) facilitate predictions of potential future impacts of taxa in the target region and elsewhere, (iv) aid the prioritisation of management actions, and (v) facilitate the evaluation of management methods. It is envisaged that EICAT will be used by scientists, environmental managers and conservation practitioners as a tool to gain a

better understanding of the magnitude of impacts caused by different alien taxa, to alert relevant stakeholders to the possible consequences of the arrival of certain alien taxa, and to inform the prioritisation, implementation and evaluation of management policies and actions.

It must be emphasised at the outset that EICAT is not a risk assessment, and its **output alone should not be used to prioritise management actions for alien taxa**. Risk assessments and priority setting require information on many issues related to the biology and ecology of the alien taxa and the pathways of introduction, which are not incorporated in EICAT. The output of EICAT is also not a statutory list of invasive alien taxa. Thus, while it is intended to inform the prioritization of management activities against alien taxa causing environmental impacts within a country or a region, EICAT should not be used alone to identify which alien taxa should be regulated. Furthermore, any decision that could have effects on the regulation of trade of species must comply with existing international agreements, including, amongst others, the CBD and its guidance on invasive alien species, the World Trade Organisation (WTO) Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement), and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). EICAT has the potential to inform statutes adhering to the relevant international agreements, to assist the implementation of appropriate measures, and to inform risk assessments, but it does not replace them.

EICAT must be applied in a consistent and comparable manner when assessing the impacts of different alien taxa. Therefore, **we present the IUCN EICAT Categories and Criteria: First edition** which should be used to inform the assessment process. The EICAT Categories and Criteria are analogous to, and draw heavily upon, the framework adopted for the globally recognised IUCN Red List of Threatened Species™ [11]. There is also a separate accompanying Guidelines document that provides additional guidance to support the application of the EICAT Categories and Criteria, including on how to deal with uncertainty, the required documentation standards, and EICAT assessment process. The EICAT Guidelines document will be periodically updated, and will be made available on the IUCN SSC ISSG website (www.issg.org).

The EICAT Categories and Criteria: First edition and the accompanying EICAT Guidelines document are adapted from – and replace – the EICAT guidelines proposed by Hawkins et al. (2015). The following EICAT Categories and Criteria: First edition and accompanying EICAT Guidelines document are therefore the documents to use when undertaking EICAT assessments.

2. Definitions

This section defines key terms used in the application of the EICAT Categories and Criteria. It is necessary to refer to these terms when interpreting them as some are commonly used terms that are defined in a particular sense here.

Taxon
This term is used for convenience to represent species or lower taxonomic levels (subspecies, varieties, cultivars, or breeds), including those that are not yet formally described.

Alien taxon
A species, subspecies or variety or cultivar or breed, moved intentionally or unintentionally by human activities beyond the limits of its native geographic range, or resulting from breeding or hybridisation and being released into an area in which it does not naturally occur. The movement allows the taxon to overcome fundamental biogeographic barriers to its natural dispersal. The definition includes any part, gametes, seeds, eggs, or propagules of such taxa that might survive and subsequently reproduce. Natural dispersal of a taxon either within postglacial habitat expansion or due to climate shift does not qualify to label a taxon as alien. Common synonyms include non-native, non-indigenous, foreign, and exotic. The definition follows the CBD (COP 6 Decision VI/23 https://www.cbd.int/decisions/cop/?m=cop-06) and [12]. See also taxon; invasive alien taxon.

Invasive alien taxon
An alien taxon whose introduction and/or spread threatens biological diversity. This definition follows the CBD (COP 6 Decision VI/23). The requirement that an invasive alien taxon causes threat or harm is common in policy usage (see also Executive Order 13112 – Invasive Species, of the United States Government), but less so in scientific usage where “invasive” usually simply implies that the taxon has spread widely and rapidly from the point of establishment [12].

Environmental impact
A measurable change to the properties of an ecosystem caused by an alien taxon [2]. This definition applies to all ecosystems, whether largely natural or largely managed by humans, but explicitly considers only changes that have impacts on the native biota. Changes in abiotic properties of the environment caused by an alien taxon are only considered if they affect the native biota. The same alien taxon may also have impacts on human societies and economies [14], but these are not considered here.

Deleterious environmental impact

An impact that changes the environment in such a way as to modify native biodiversity or alter ecosystem properties to the detriment of native taxa [15]. This definition intentionally excludes societal judgments regarding the desirability or value of alien taxa, and it is assumed here that the classification will be used as a mechanism to prevent impacts that are judged to be "negative" by those concerned.

Global population

The total number of individuals of a taxon. See also population size.

Sub-population and local population

A sub-population is a geographically or otherwise distinct group in the global population for which there is little demographic or genetic exchange. A local population is a group of individuals within a sub-population. It may encompass all of the individuals within the sub-population (e.g., local population 1 in Figure 1), or only some of those individuals (e.g., local populations 2 – 4 in Figure 1). In the latter case, a local population is spatially disjunct from other groups of individuals, but shares individuals with other local populations through natural immigration, in which case it may form part of a meta-population [16]. An EICAT assessment considers impacts happening at least at the level of the local population. See also population size.

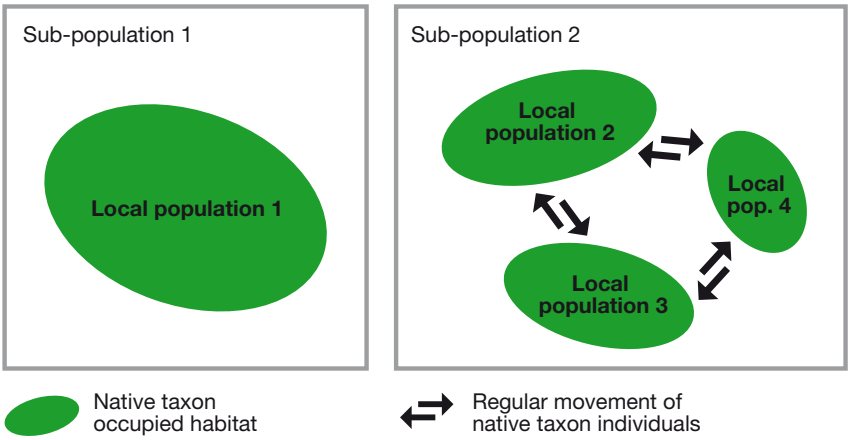

Figure 1. The relationship between global population, sub-population and local population for the purposes of EICAT assessments. The global population includes all individuals of the taxon, a sub-population is a geographically or otherwise distinct group in the population, and a local population is a group of individuals within a sub-population. In this example, local population 1 includes all individuals within sub-population 1. Local populations 2, 3 and 4 are connected by frequent natural immigration, whereas sub-populations 1 and 2 are largely isolated from each other.

Population size

For functional reasons, primarily owing to differences between life forms, population size (whether global, sub or local) is measured as numbers of mature individuals only. In the case of taxa dependent on other taxa for all or part of their life cycles, biologically appropriate values for the host taxon should be used.

Mature individuals

Mature individuals are the number of individuals known, estimated or inferred to be capable of reproduction. When estimating this quantity, the following points should be considered:

- 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.
- Where the population size fluctuates, use a lower estimate. In most cases this will be much less than the mean.
- Reproducing units within a clone should be counted as individuals, except where such units are unable to survive alone.
- 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.

Native community
The assemblage of populations of naturally occurring taxa present in the area occupied by the alien taxon.

Changes to a community
Changes to a community refer to the loss of at least one native species in a community (local population extinction of one or more native species) due to impacts caused by the alien taxon.

Performance
Performance is a measurable fitness trait that affects the capacity of an individual organism to survive, gather resources, grow, or reproduce [see 17, 18]. Examples include biomass, plant height, number of offspring or seeds, and immunocompetence.

Decline in population size
A decline in global, sub- or local population size is a reduction in the number of mature individuals of a native species resulting from the introduction of the alien taxon. The downward phase in a normally fluctuating population will not count as a reduction. In cases where an alien taxon impacts the recruitment of native species, this impact will not count as a reduction in population size, unless there is also an impact on the number of mature individuals.

Local population extinction
The elimination of one or more native taxa due to impacts caused by the alien taxon, in part or all of the area invaded by the alien taxon (also known as extirpation). A native taxon is presumed locally extinct when there is evidence from known and/or expected habitat within the local area invaded by the alien taxon that no individuals of the native taxon remain. Local population extinction differs from global (species) extinction, which refers to the complete elimination of a native taxon from all parts of its range. In situations where a species is only known from one locality, local population extinction may also result in the species' global extinction. This may occur on islands for example, if the introduction of an alien taxon leads to the local extinction of an island endemic species.

Naturally reversible changes

Following on from a local population extinction, naturally reversible means there is evidence that if the alien taxon is no longer present, the native taxon would be likely to return to the community within 10 years or 3 generations, whichever is longer. The native taxon can return to the community naturally (e.g., individuals migrating from a metapopulation), or assisted by human re-introductions, either intentionally or unintentionally, but only where the re-introductions were occurring at a similar rate before the alien taxon led to the native species local population extinction, and the re-introductions are not for conservation purposes. Therefore, re-introductions assisted by humans that were not already in place at the time the alien taxon led to the local population extinction, and that would require extra effort (e.g., re-introductions from captivity or from other areas), are not considered as naturally reversible changes.

Naturally irreversible changes

Naturally irreversible means there is evidence that if the alien taxon is no longer present, the native species would not return to the community within 10 years or 3 generations, whichever is longer, without additional human assistance that was not already in place at the time the alien taxon led to the local population extinction (see naturally reversible changes). Local extinctions are naturally irreversible when there is no propagule influx of the native taxon (e.g., global extinction, isolation of the local population), or when the alien population changes the environment making it unsuitable for the native taxon to re-establish.

3. Description of the EICAT Categories and Criteria

3.1. Categories

The impacts of an alien taxon are classified based on the level of biological organisation it affects (individuals → populations → communities), and the magnitude and reversibility of these impacts. The impact category assigned to an alien taxon should reflect its most severe impact to native taxa under any of the criteria listed in section 4.2.

There are eight clearly defined categories into which taxa can be classified (Figure 2). Complete definitions of the categories are given in Box 1. The first five categories, termed ***'impact'*** categories, follow a sequential series of impact scenarios describing increasing levels of impact by alien taxa. These scenarios have been designed such that each step change in category reflects an increase in the order of magnitude of the particular impact so that a new level of biological organisation is involved. Thus: **Minimal Concern (MC)** – negligible impacts, and no reduction in performance of a native taxon's individuals; **Minor (MN)** – performance of individuals reduced, but no decrease in population size; **Moderate (MO)** – native taxon population decline; **Major (MR)** – native taxon local extinction (i.e. change in community structure), which is naturally reversible; and **Massive (MV)** – naturally irreversible local, or global extinction of a native taxon (i.e. change in community structure). Alien taxa should be classified based on the highest criterion level met across any of the impact mechanisms (section 4.2, Table 1). Impacts that fall within the categories **Moderate**, **Major** or **Massive** are termed ***'harmful'***.

The remaining three categories do not reflect the impact status of a taxon. The **Data Deficient (DD)** category highlights taxa for which evidence suggests that alien populations exist, but for which current information is insufficient to assess their level of impact. The category **No Alien Population (NA)** should be applied when there is no evidence to suggest the taxon has or had individuals existing in the wild (i.e. outside of captivity), beyond the boundary of its native geographic range. The category **Not Evaluated (NE)** applies to taxa that have not yet been evaluated against the EICAT impact categories.

Finally, the label **Cryptogenic (CG)** should be applied to taxa for which it is unclear, following evaluation, whether individuals present at a location are native or alien [13]. **CG** is not a category in itself; cryptogenic taxa should be evaluated as if they are aliens, on the basis of the precautionary principle, but their impact classification modified by the **CG** label (e.g., for a cryptogenic species with Major impact: *Genus species* **MR** [**CG**]).

Box 1. Category definitions
The abbreviation of each category (in parenthesis) follows the denomination.

Minimal Concern (MC)
A taxon is considered to have impacts of **Minimal Concern** when it causes negligible levels of impacts, but no reduction in performance of individuals in the native biota. Note that all alien taxa have impacts on the recipient environment at some level, for example by altering species diversity or community similarity (e.g., biotic homogenisation), and for this reason there is no category equating to "no impact". Only taxa for which changes in the individual performance of natives have been studied but not detected are assigned an **MC** category. Taxa that have been evaluated under the EICAT process but for which impacts have not been assessed in any study should not be classified in this category, but rather should be classified as **Data Deficient**.

Minor (MN)
A taxon is considered to have **Minor** impacts when it causes reductions in the performance of individuals in the native biota, but no declines in native population sizes, and has no impacts that would cause it to be classified in a higher impact category.

Moderate (MO)
A taxon is considered to have **Moderate** impacts when it causes declines in the population size of at least one native taxon, but has not been observed to lead to the local extinction of a native taxon.

Major (MR)
A taxon is considered to have **Major** impacts when it causes community changes through the local or sub-population extinction (or presumed extinction) of at least one native taxon, that would be naturally reversible if the alien taxon was no longer present. Its impacts do not lead to naturally irreversible local population, sub-population or global taxon extinctions.

Massive (MV)
A taxon is considered to have **Massive** impacts when it causes naturally irreversible community changes through local, sub-population or global extinction (or presumed extinction) of at least one native taxon.

Data Deficient (DD)
A taxon is categorised as **Data Deficient** when the best available evidence indicates that it has (or had) individuals existing in a wild state in a region beyond the boundary of its native geographic range, but either there is inadequate information to classify the taxon with respect to its impact, or insufficient time has elapsed since introduction for impacts to have become apparent. It is expected that all introduced taxa will have an impact at some level, because by definition an alien taxon in a new environment has a nonzero impact. However, listing a taxon as **Data Deficient** recognises that current information is insufficient to assess that level of impact.

No Alien Populations (NA)
A taxon is categorised as having **No Alien Populations** when there is no reliable evidence that it has (or had) individuals existing in a wild state in a region beyond the boundary of its native geographic range. In this case, absence of evidence is assumed to be evidence of absence, as it is impossible to prove that a taxon has no alien individuals anywhere in the world. Taxa with individuals kept in captivity or cultivation in an area to which it is not native would be classified here. A taxon could currently have no individuals existing in a wild state in a region beyond the boundary of its native geographic range because it has died out in, or has been eradicated from, such an area. In these cases, there should be evidence relating to impact that causes it to be classified in one of the impact categories (**MC**, **MN**, **MO**, **MR**, **MV**), or alternatively no evidence of impact, which would cause it to be classified as **DD**.

Not Evaluated (NE)
A taxon is categorised as **Not Evaluated** when it has not yet been evaluated against the EICAT impact categories.

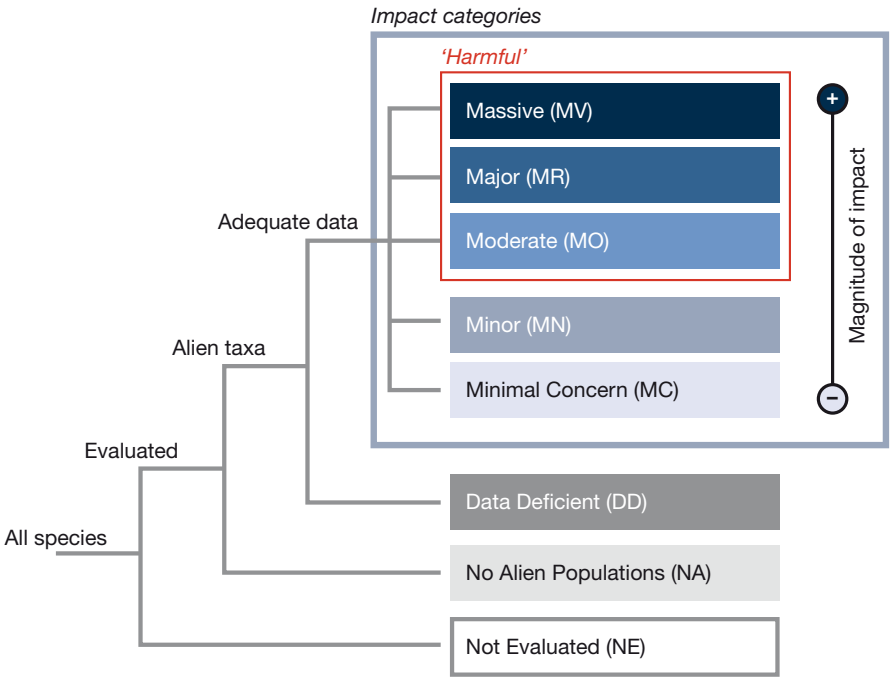

Figure 2. The different EICAT categories and the relationship between them. Descriptions of the categories are provided in Box 1. The cryptogenic (CG) label is not represented here as CG taxa may be found in any category.

Cyrptogenic species are a particular problem in the marine realm, for cosmopolitan plants, for species that spread easily, for taxa possibly introduced into a location many centuries ago, and for species from taxonomic groups who's biogeography is poorly understood, including many stored product arthropod pests, for which the native geographic ranges are unknown. Cryptogenic taxa may have deleterious impacts where they occur.

In many cases, it is difficult to distinguish whether an alien taxon is the driver of environmental changes, or simply a passenger responding to the same driver as the natives [19]. Moreover, synergistic interactions between alien taxa and other stressors are also possible (and perhaps increasingly common) but difficult to anticipate [20]. The EICAT scheme takes a precautionary approach: when the main driver of change is unclear, it should be assumed to be the alien taxon for the purposes of the EICAT assessment. However, the classification is intended to be dynamic, allowing for updates as new or more reliable data become available, and as the documented impact history of a taxon unfolds across space and time.

3.2. Criteria

Twelve **impact mechanisms** have been identified by which alien taxa may cause deleterious impacts in areas to which they have been introduced (Table 1). For each mechanism, there are five criteria against which taxa should be evaluated, to determine the level of deleterious impact caused under that mechanism. Taxa should be evaluated against every relevant mechanism and criterion, and the highest level of criterion met under any mechanism then determines the EICAT category to which the taxon is assigned. These mechanisms are based on those proposed by Nentwig *et al.* 2010 [21], Kumschick *et al.* 2012 [22] and Blackburn *et al.* 2014 [10]. They are aligned with those identified in the IUCN Global Invasive Species Database (GISD) http://www.iucngisd.org/gisd/.

The impact mechanisms are:

1. **Competition** – the alien taxon competes with native taxa for resources (e.g., food, water, space), leading to deleterious impact on native taxa.
2. **Predation** – the alien taxon predates on native taxa, leading to deleterious impact on native taxa.
3. **Hybridisation** – the alien taxon hybridises with native taxa, leading to deleterious impact on native taxa.
4. **Transmission of disease** – the alien taxon transmits diseases to native taxa, leading to deleterious impact on native taxa.
5. **Parasitism** – the alien taxon parasitises native taxa, leading to deleterious impact on native taxa.
6. **Poisoning/toxicity** – the alien taxon is toxic, or allergenic by ingestion, inhalation or contact, or allelopathic to plants, leading to deleterious impact on native taxa.
7. **Bio-fouling or other direct physical disturbance** – the accumulation of individuals of the alien taxon on the surface of a native taxon (i.e., bio-fouling), or other direct physical disturbances not involved in a trophic interaction (e.g., trampling, rubbing, etc.) leads to deleterious impact on native taxa.
8. **Grazing/herbivory/browsing** – grazing, herbivory or browsing by the alien taxon leads to deleterious impact on native taxa.
9. **Chemical impact on ecosystem** – the alien taxon causes changes to the chemical characteristics of the native environment (e.g., pH; nutrient and/or water cycling), leading to deleterious impact on native taxa.
10. **Physical impact on ecosystem** – the alien taxon causes changes to the physical characteristics of the native environment (e.g., disturbance or light regimes), leading to deleterious impact on native taxa.
11. **Structural impact on ecosystem** – the alien taxon causes changes to the habitat structure (e.g., changes in architecture or complexity), leading to deleterious impact on native taxa.
12. **Indirect impacts through interactions with other species** – the alien taxon interacts with other native or alien taxa (e.g., through any mechanism, including pollination, seed dispersal, apparent competition, mesopredator release), facilitating indirect deleterious impact on native taxa.

Alien taxa should be assessed for their impact under all the mechanisms for which data are available, and classified on the basis of evidence of their most severe impacts under any of the impact mechanisms. For a taxon to qualify in any of the EICAT impact categories (**MC**, **MN**, **MO**, **MR**, **MV**), evidence of impact is needed for one (or more) of the twelve mechanisms that caused the highest impact. The criteria used for classifying impacts associated with each impact mechanism are described in Table 1. Impacts which do not fit any of the mechanisms can still be classified, based on the general rules given in the top row of Table 1.

These categories are for taxa that have been evaluated, have alien populations (i.e., are known to have been introduced outside their native range), and for which there is adequate data to allow classification (see Figure 2). Classification follows the general principle outlined in the first row. However, the different mechanisms through which an alien taxon can cause impacts are outlined, in order to guide the assessment process.

Table 1. Criteria used to classify alien taxa by EICAT impact category (MC, MN, MO, MR, MV).

	Massive (MV)	Major (MR)	Moderate (MO)	Minor (MN)	Minimal Concern (MC)
Categories should adhere to the following general meaning	*Causes local extinction of at least one native taxon (i.e., taxa vanish from communities at sites where they occurred before the alien arrived), which is naturally irreversible; even if the alien taxon is no longer present the native taxon cannot recolonise the area*	*Causes local or sub-population extinction of at least one native taxon (i.e., taxa vanish from communities at sites where they occurred before the alien arrived); which is naturally reversible if the alien taxon is no longer present*	*Causes population decline in at least one native taxon, but no local population extinction*	*Causes reduction in individual performance (e.g., growth, reproduction, defence, immunocompetence), but no decline in local native population sizes*	Negligible level of impact; no reduction in performance (e.g., growth, reproduction, defence, immunocompetence) of individuals of native taxa
Mechanisms					
(1) Competition	Competition resulting in replacement or local extinction of one or several native taxa; changes are naturally irreversible	Competition resulting in local population extinction of at least one native taxon, but changes are naturally reversible when the alien taxon is no longer present	Competition resulting in a decline of population size of at least one native taxon, but no local population extinction	Competition affects performance of native individuals without decline of their populations	Negligible level of competition with native taxa; reduction of performance of native individuals is not detectable
(2) Predation	Predation results in local extinction of one or several native taxa; changes are naturally irreversible	Predation results in local population extinction of at least one native taxon; naturally reversible when the alien taxon is no longer present	Predation results in a decline of population size of at least one native taxon, but no local population extinction	The alien taxon preys on native taxa, without leading to a decline in their populations	Not applicable; predation on native taxa is classified at least as MN
(3) Hybridisation	Hybridisation between the alien taxon and native taxa leading to the loss of at least one pure native local population (genomic extinction); pure native taxa cannot be recovered even if the alien and hybrids are no longer present	Hybridisation between the alien taxon and native taxa leading to the loss of at least one pure native local population (genomic extinction); naturally reversible when the alien taxon and hybrids are no longer present	Hybridisation between the alien taxon and native taxa is regularly observed in the wild; local decline of populations of at least one pure native taxon, but pure native taxa persist	Hybridisation between the alien taxon and native taxa is observed in the wild, but rare; no decline of pure local native populations	No hybridisation between the alien taxon and native taxa observed in the wild (prezygotic barriers), hybridisation with a native taxon is possible in captivity

	Massive (MV)	Major (MR)	Moderate (MO)	Minor (MN)	Minimal Concern (MC)
(4) Transmission of disease to native species	Transmission of disease to native taxa resulting in local extinction of at least one native taxon; changes are naturally irreversible	Transmission of disease to native taxa resulting in local population extinction of at least one native taxon; naturally reversible when the alien taxon is no longer present	Transmission of disease to native taxa resulting in a decline of population size of at least one native taxon, but no local population extinction; disease is severely affecting native taxa, including mortality of individuals, and it has been found in native and alien co-occurring individuals (same time and space)	Transmission of disease to native taxa affects performance of native individuals without leading to a decline of their populations; alien taxon is a host of a disease which has also been detected in native taxa and affects the performance of native taxa	The alien taxon is a host or vector of a disease transmissible to native taxa but disease not detected in native taxa; reduction in performance of native individuals is not detectable
(5) Parasitism	Parasites or pathogens directly result in local extinction of one or several native taxa; changes are naturally irreversible	Parasites or pathogens directly result in local population extinction of at least one native taxon, but changes are naturally reversible when the alien taxon is no longer present	Parasites or pathogens directly result in a decline of population size of at least one native taxon, but no local population extinction	Parasites or pathogens directly affect performance of native individuals without decline of their populations	Negligible level of parasitism or disease incidence (pathogens) on native taxa, reduction in performance of native individuals is not detectable
(6) Poisoning/ toxicity	The alien taxon is toxic/ allergenic by ingestion, inhalation, or contact to wildlife or allelopathic to plants, resulting in local extinction of at least one native taxon; changes are naturally irreversible	The alien taxon is toxic/ allergenic by ingestion, inhalation, or contact to wildlife or allelopathic to plants, resulting in local population extinction of at least one native taxon, but changes are naturally reversible when the alien taxon is removed	The alien taxon is toxic/ allergenic by ingestion, inhalation, or contact to wildlife or allelopathic to plants, resulting in a decline of population size of at least one native taxon, but no local population extinction	The alien taxon is toxic/allergenic by ingestion, inhalation, or contact to wildlife or allelopathic to plants, affecting performance of native individuals without decline of their populations	The alien taxon is toxic/ allergenic/ allelopathic, but the level is very low, reduction of performance of native individuals is not detectable

	Massive (MV)	Major (MR)	Moderate (MO)	Minor (MN)	Minimal Concern (MC)
(7) Bio-fouling or other direct physical disturbance	Bio-fouling or other direct physical disturbance resulting in local extinction of one or several native taxa; changes are naturally irreversible	Bio-fouling or other direct physical disturbance resulting in local population extinction of at least one native taxon, but changes are naturally reversible when the alien taxon is no longer present	Bio-fouling or other direct physical disturbance resulting in a decline of population size of at least one native taxon, but no local population extinctions	Bio-fouling or other direct physical disturbance affects performance of native individuals without decline of their populations	Negligible level of bio-fouling or direct physical disturbance on native taxa; reduction in performance of native individuals is not detectable
(8) Grazing/ herbivory/ browsing	Herbivory/grazing/ browsing resulting in local extinction of one or several native taxa; changes are naturally irreversible	Herbivory/grazing/ browsing resulting in local population extinction of at least one native taxon, but changes are naturally reversible when the alien taxon is no longer present	Herbivory/grazing/ browsing resulting in a decline of population size of at least one native taxon, but no local population extinction	Herbivory/grazing/ browsing affects performance of individuals of native taxa without decline of their populations	Negligible level of herbivory/grazing/ browsing on native taxa, reduction in performance of native taxa is not detectable
(9) Chemical impact on ecosystems	Changes in chemical ecosystem characteristics (e.g., changes in nutrient cycling, pH) resulting in local extinction of at least one native taxon; changes are naturally irreversible	Changes in chemical ecosystem characteristics (e.g., changes in nutrient cycling, pH) resulting in local population extinction of at least one native taxon, but changes are naturally reversible when the alien taxon is no longer present	Changes in chemical ecosystem characteristics (e.g., changes in nutrient cycling, pH) resulting in a decline of population size of at least one native taxon, but no local population extinction	Changes in chemical ecosystem characteristics (e.g., changes in nutrient cycling, pH) affecting performance of native individuals without decline of their populations	Changes in chemical ecosystem characteristics detectable (e.g., changes in nutrient cycling, pH), but no reduction in performance of native individuals detectable

	Massive (MV)	Major (MR)	Moderate (MO)	Minor (MN)	Minimal Concern (MC)
(10) Physical impact on ecosystems	Changes in physical ecosystem characteristics (e.g., changes in temperature, fire or light regime) resulting in local extinction of native taxa; changes are naturally irreversible	Changes in physical ecosystem characteristics (e.g., changes in temperature, fire or light regime) resulting in local population extinction of at least one native taxon, but changes are naturally reversible when the alien taxon is no longer present	Changes in physical ecosystem characteristics (e.g., changes in temperature, fire or light regime) resulting in a decline of population size of at least one native taxon, but no local population extinction	Changes in physical ecosystem characteristics (e.g., changes in temperature, fire or light regime) affecting performance of native individuals without decline of their populations	Changes in physical ecosystem characteristics detectable (e.g., changes in temperature, fire or light regime), but no reduction in performance of native individuals detectable
(11) Structural impact on ecosystems	Changes in structural ecosystem characteristics (e.g., changes in architecture or complexity) resulting in local extinction of native taxa; changes are naturally irreversible	Changes in structural ecosystem characteristics (e.g., changes in architecture or complexity) resulting in local extinction of at least one native taxon, but changes are naturally reversible when the alien taxon is no longer present	Changes in structural ecosystem characteristics (e.g., changes in architecture or complexity) resulting in a decline of population size of at least one native taxon, but no local population extinction	Changes in structural ecosystem characteristics (e.g., changes in architecture or complexity) affecting performance of native individuals without decline of their populations	Changes in structural ecosystem characteristics detectable (e.g., changes in architecture or complexity), but no reduction in performance of native individuals detectable
(12) Indirect impacts through interaction with other species	Interaction of an alien taxon with other taxa leading to indirect impacts (e.g., pollination, seed dispersal, apparent competition) causing local extinction of one or several native taxa, leading to naturally irreversible changes that would not have occurred in the absence of the alien taxon	Interaction of an alien taxon with other taxa leading to indirect impacts (e.g., pollination, seed dispersal, apparent competition) causing local population extinction of at least one native taxon; changes are naturally reversible but would not have occurred in the absence of the alien taxon	Interaction of an alien taxon with other taxa leading to indirect impacts (e.g., pollination, seed dispersal, apparent competition) causing a decline of population size of at least one native taxon, but no local population extinction; impacts would not have occurred in the absence of the alien taxon	Interaction of an alien taxon with other taxa leading to indirect impacts (e.g., pollination, seed dispersal, apparent competition) affecting performance of native individuals without decline of their populations; impacts would not have occurred in the absence of the alien taxon	Interaction of an alien taxon with other taxa leading to indirect impacts (e.g., pollination, seed dispersal, apparent competition) but reduction in performance of native individuals is not detectable

4. Applying EICAT

4.1. Evidence-based scheme

EICAT assessments are based on available data, published or unpublished, on the environmental impacts of alien taxa. While EICAT provides important insights into the threat posed to new regions, it is based only on impacts that have actually been observed, or inferred based on evidence, in the introduced range. Potential impact is an estimate of the magnitude of impact that would result if an invasion occurred, which might incorporate information from the native range, trait analyses and mechanistic models. Potential impact is an essential part of risk assessment, but is not part of EICAT. The classification should not be used alone as a proxy for potential impact. Furthermore, EICAT is solely concerned with impacts in the alien range of a taxon and data and observations from the native range should not be used in assessing impacts under EICAT. Where there is uncertainty as to whether a study is in the native range or not, this should be recorded in the essential documentation.

4.2. Taxonomic scope

The EICAT process may be applied to species, subspecies or (for plants) varieties or cultivars, or (for animals) breeds introduced outside their natural past or present distribution (CBD COP 6 Decision VI/23) or to newly occurring taxa arising from breeding or hybridisation. For any EICAT assessment, the taxonomic unit used (species, subspecies, lower taxon) should be specified in the supporting documentation.

Note that invasion, and by extension impact, is a characteristic of a population, rather than a species: not all populations of a given taxon cause the same impacts. It follows that the EICAT classification of a taxon will generally reflect impacts recorded from one or a small number of populations, and that population level impacts translate into taxon-level assessments. This reflects the precautionary principle, as impact caused by one population suggests the potential for other alien populations of the same taxon to cause similar impacts elsewhere.

4.3 Lack of evidence of impact

EICAT is applicable to alien populations occurring in any biome; terrestrial, freshwater, or marine. However, the impacts of alien populations within some habitats will initially be less studied than within others, and therefore it is important that a lack of evidence of impacts is not interpreted as lack of impact. Within EICAT, lack of evidence of impact (categorised as **DD**) is treated differently to evidence of lack of impact (categorised as **MC**).

4.4. Spatial and temporal scale of impact

Assessments using EICAT are undertaken on impact data currently available for alien taxa at appropriate spatial and temporal scales. This needs to take into account the typical spatial and temporal scales over which the original native communities 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.

4.5. Classification

Assessments using EICAT Categories and Criteria are undertaken on evidence of impacts at the appropriate spatial and temporal scales. An alien taxon may have been subject to many different assessments of impact, each with a different EICAT classification (Figure 3). The final EICAT category assigned to the alien taxon is the maximum recorded impact across all of the different impact assessments (Figure 3).

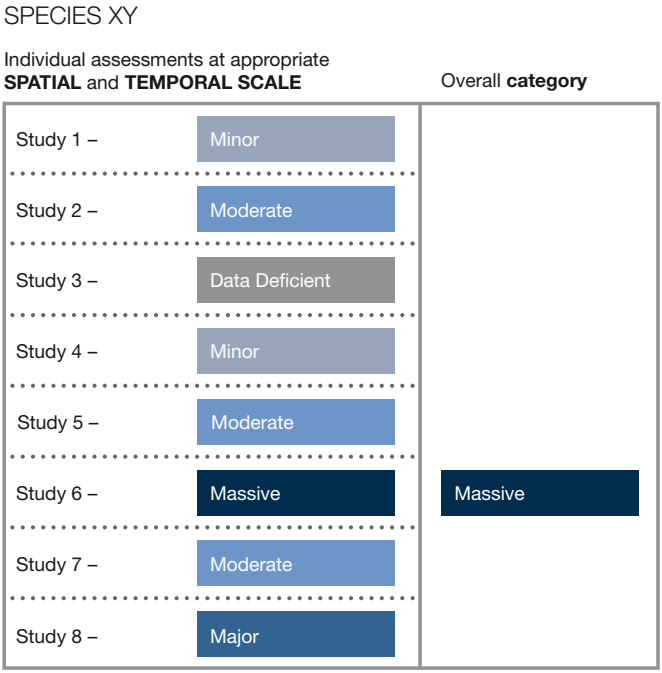

Figure 3. How data from individual EICAT assessments of the impacts of a hypothetical alien taxon (species XY) inform the overall EICAT Category to which the taxon is assigned. The overall assessment categorises the taxon based on its highest impact anywhere (in this case, Massive (MV)).

It is likely that some alien taxa will be subject to management plans to control or eradicate their populations in invaded areas. A possible result is that the current highest level of impact caused by the taxon is below the highest level of impact ever recorded for the taxon (i.e. before the management took place). However, due to the known potential of the taxon to cause the highest level of impact, the maximum recorded impact remains the IUCN EICAT category assigned to the taxon.

4.6. Geographic scale of the classification

IUCN currently only reviews and displays global assessments. Global assessments are based on evidence of impact from the taxon's entire alien range, and the highest level of impact recorded anywhere in the alien range of the taxon being assessed. In practice, as most alien taxa with recorded impacts are yet to have their impacts studied in most areas where they occur, the vast majority of EICAT assessments will use data from only part of the alien range to generate a global level taxon assessment. While the EICAT Categories and Criteria are focused only on assessments undertaken at the global scale, the EICAT process can be applied to impacts at different geographic scales, including regional, national or local (Figure 4). However, impact listings are likely to be context dependent: an impact that is observed in one area of the introduced range may not occur elsewhere, or may not be as severe elsewhere. Therefore, national or regional level assessments, which only take into account impacts which have occurred within a particular country or region, may differ markedly from global level assessments which are based on the highest level of impact recorded anywhere in the alien range of the taxon being assessed (Figure 4). Regardless of the geographic scale of the assessment, evidence of the impacts of alien taxa used for the assessment should be measured at an appropriate spatial scale, taking into account the typical spatial and temporal scale at which the invaded native communities can be characterised.

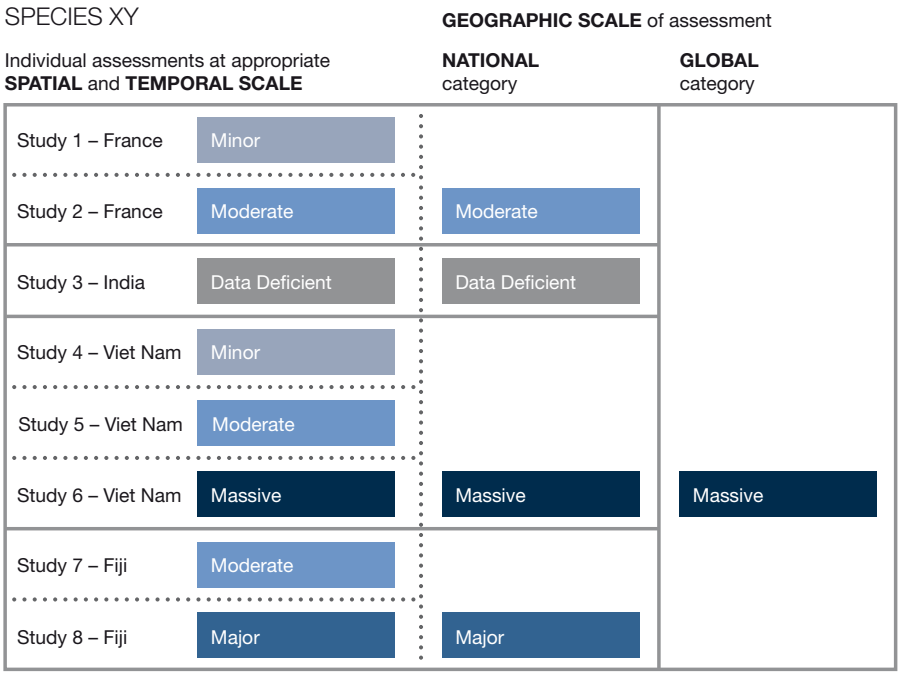

Figure 4. How data from individual EICAT assessments of the impacts of a hypothetical alien taxon (species XY) inform the EICAT category to which the taxon is assigned at national and global scales. The global assessment categorises the taxon based on its highest impact anywhere (in this case, a Massive (MV) impact in Viet Nam). National scale assessments are based only on impacts reported from those countries (e.g. Major (MR) for Fiji). Data Deficient (DD) in India indicates that the alien taxon was assessed but no impact reports from India were found.

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