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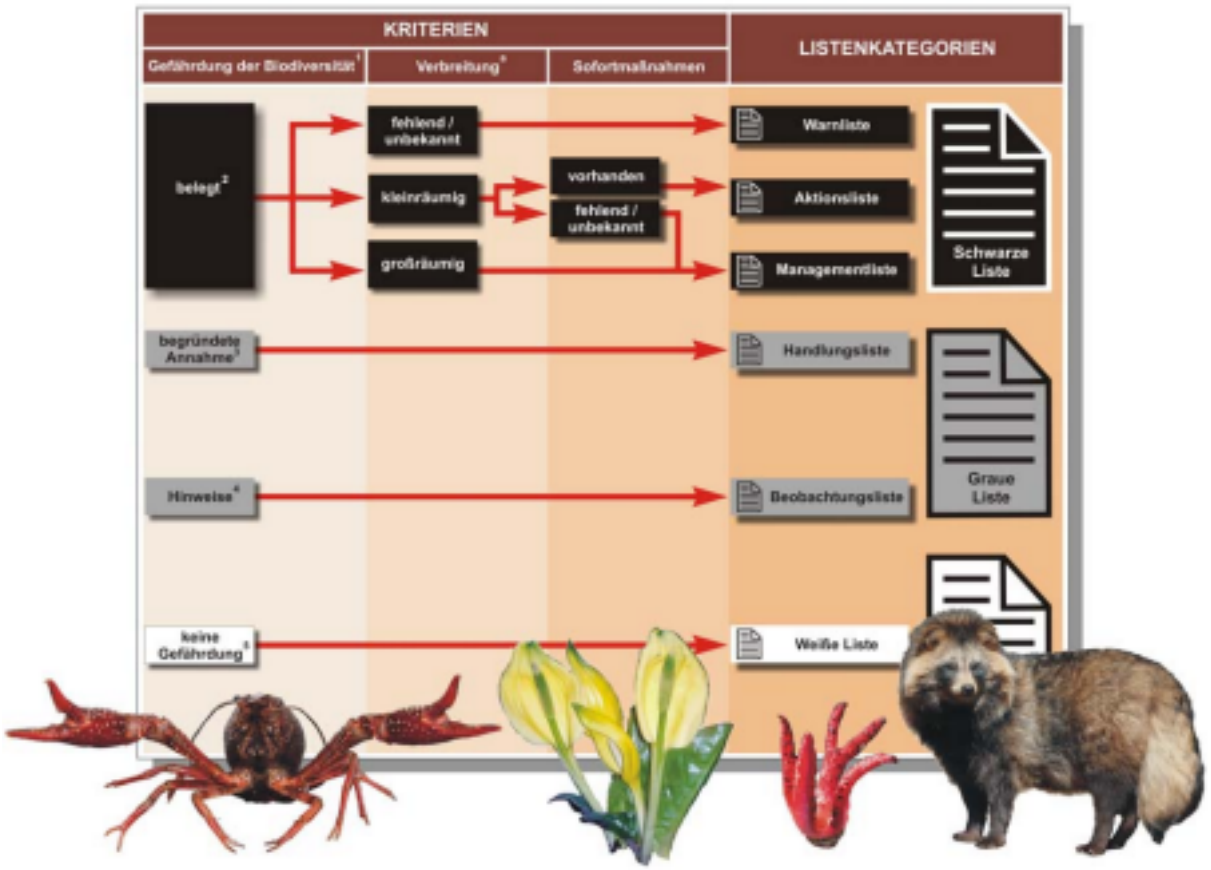
Methodology of nature conservation invasiveness assessment for alien species

Version 1.2



Bundesamt für Naturschutz

PERSPEKTIVEN FÜR UMWELT & GESELLSCHAFT umweltbundesamt

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2013

Methodology of nature conservation invasiveness assessment for

alien species

Version 1.2

Using results from the R&D projects FKZ 806 82 330, FKZ 3510 86 0500 and FKZ 3511 86 0300

Stefan Nehiring
Franz Essl
Wolfgang Rabitsch

Cover photo: The methodology of nature conservation invasiveness assessment can be applied to all alien species. They are representative of the group of invertebrates *Pro cambarus clarkii* (Red swamp crayfish), of plants *Lysichiton americanus* (Yellow shine kalla), of mushrooms *Clathrus archeri* (squid fungus) and vertebrates *Nyctereutes pro cyonoides* (raccoon dog) pictured. (Graphics ©BfN, photos from left to right ©S. Nehring, ©B. Albert Ernst, ©Wilhelma/L. Siermann, ©S. Nehring).

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Japanese knotweed (*Fallopia* spp.) have a particularly wide ecological amplitude (© S. Nehring).

FOREWORD

The intentional importation and unintentional introduction of alien species represent an important cause of threats to biological diversity worldwide.

However, the invasiveness of alien species varies greatly. For the efficient use of resources to defend and eliminate alien species, knowledge about the respective threat potential of an alien species for biodiversity is an essential prerequisite. The Federal Agency for Nature Conservation, in collaboration with the Austrian Federal Environment Agency, has therefore developed a methodology that enables an assessment of the nature conservation threat potential of alien species. The instrument is intended to ensure that species that are problematic, i.e. invasive, for Germany and Austria can be identified.

The chosen approach is based on a clearly defined system of criteria - so the classification is verifiable and comprehensible. The criteria system is deliberately kept simple and based on similar European models to ensure its practicability. The assessment leads to classification into list categories, from which action requirements and priorities for nature conservation can be derived. The set of criteria is aimed at recording and evaluating negative impacts in terms of nature conservation, while economic and health effects are named but are not included in the classification process.

The instrument is not a substitute for in-depth scientific studies on the threat potential of alien species. On the contrary, it is intended to help identify, research and resolve gaps in knowledge.

In both countries, after the successful application of the "methodology of nature conservation invasiveness assessment" for a large number of alien species, detailed information has emerged to provide more detailed definitions of individual criteria or comments on their scaling in order to make the use of the methodology even more user-friendly. With this publication, the method and its updates are merged in an updated version as version 1.2.

For nature conservation in Germany and Austria, within the framework of implementing the requirements of the Biological Diversity Convention and the German Federal Nature Conservation Act and taking current European developments into account, a methodology is available that enables a transparent assessment of the threat potential of alien species to biodiversity. Based on this, the need for action and priorities for management at the federal and regional level can then be derived in a targeted manner.

It will now be important to continue to critically monitor the evaluation system in practical tests in order to be able to take advantage of opportunities to further develop the instrument. In this sense, we are open and grateful for constructive feedback.

The red swamp crab (*Procambarus clarkii*) endangers native crayfish (© S. Nehring).

METHODOLOGY OF NATURE CONSERVATION

INVASIVITY ASSESSMENT FOR ALIEN SPECIES, VERSION 1.2

1 INTRODUCTION AND INITIAL SITUATION

In recent decades, the number of alien species in Central Europe has increased sharply, particularly against the background of massively growing trade flows (LAMBDON et al. 2008). The dispersal process continues unabated, particularly for recently introduced species, which are often at the beginning of a rapid further spread. Given the predicted global warming, this dynamic is expected to further strengthen in the future (pLANDet al. 2000). In nature conservation, special attention is paid to those alien species that cause relevant ecological damage and are therefore viewed as invasive (invasive alien species, IAS). There is therefore a need for clear principles and criteria that can be used to identify invasive species among the large number of mostly unproblematic alien species (neobiota). Only in this way is it possible, among other things, to take effective and cost-effective measures in an early phase of spread using an early warning and forecasting system that help prevent the further spread of invasive species.

Based on international environmental agreements, the focus of nature conservation is on preserving biodiversity. The Convention on Biological Diversity obliges the international community to take precautions against invasive species and, if necessary, to combat them (CBD 1992, 2000, 2002).

An important milestone in the implementation of the requirements of the Biological Diversity Convention in Germany is the amendment to the Federal Nature Conservation Act (BNatschG) of July 29, 2009. The new BNatSchG came into force on March 1, 2010 and, in Section 40, applies the framework of the old BNatSchG with regard to non-resident species types, but designs them yourself. The new BNatSchG takes into account the three-stage, hierarchical approach of the CBD, which is based on the precautionary principle,

1) to initially prevent the introduction of non-native or invasive species (Section 40 Paragraph 1) and

2) if this is not sufficient, to immediately eliminate newly emerging invasive species that endanger naturally occurring ecosystems, biotopes or species through emergency measures or to prevent their

spread (Section 40 Paragraph 3 Sentence 1) and

3) in the case of common invasive species - if promising and proportionate - to at least prevent further spread and reduce the effects of the spread through control measures as part of damage limitation (Section 40 Paragraph 3 Sentence 2). Species for which the potential for problems is still unclear and more knowledge needs to be available in order to take action if necessary should be observed (§ 40 para. 2).

For the successful implementation of the new BNatSchG by the responsible federal and state authorities, it is therefore essential to use a transparent assessment procedure with regard to invasiveness, to install an early detection system and a monitoring program for invasive species as well as an observation program for potentially invasive species . Measures to eliminate and control invasive species must be developed and implemented if necessary. Success controls should be used to check the effectiveness of measures.

Taking up the above-mentioned developments, the Federal Agency for Nature Conservation, in collaboration with the Austrian Federal Environment Agency, has developed a cross-taxon and cross-border assessment concept for alien species in Central Europe. The “Methodology of the nature conservation invasiveness assessment of alien species” and the invasiveness assessments for the group of alien fish were published in the series of publications in 2010*BfN scripts*published (NEHRING et al. 2010). The methodology was published internationally in 2011*Journal for Nature Con servation* (ANDSSL et al. 2011).

The “Methodology of Nature Conservation Invasiveness Assessment for Alien Species” is intended to provide nature conservationists with a practical tool to evaluate alien species and identify them as invasive species. On this basis, the need for action and priorities when dealing with alien species can then be derived in a targeted manner.

It is important, as is NEHRING et al. (2010) and ESSL et al. (2011) emphasized that the methodology should be critically monitored in practical tests in order to be able to take advantage of opportunities to further develop this nature conservation instrument. Since its publication, the methodology has been updated as part of two subsequent BfN R&D projects:

- Creation of a warning list of invasive animals and plants that are not yet present in Germany (FKZ 3510 86 0500): Contractor Federal Environment Agency Vienna, with the participation of other experts (see also RABITSCH et al. 2013).
- Nature conservation invasiveness assessments of alien vascular plants and vertebrates occurring in Germany (FKZ 3510 86 0500): Contractor Technical University of Berlin, with the participation of other experts (publication in preparation).

In this BfN script, the method and its updates are combined in an updated version as version 1.2. Changes to date essentially only concern definitions of individual criteria or comments on their scaling in order to make the methodology even more user-friendly. No changes were made to the structure of the criteria system or the classification process. All previously published invasiveness assessments therefore remain valid.

The methodology is divided into a) general ones**Basics**with specifications regarding, among other things, terms, list categories and damage thresholds (Chapter 3) as well as b) in**the criteria system and its application**, which leads to an assignment to a list category (black, gray or white list) with a corresponding classification of invasiveness (invasive, potentially invasive, not yet invasive) (Chapter 4).

The spread of the butterfly bush (*Buddleja davidii*) becomes limited by winter frosts (© U. Albrecht).

2 GOALS AND POSSIBLE APPLICATIONS NATURE PROTECTION OF PROFESSIONAL INVASIVITY ASSESSMENTS

The most important goal of nature conservation invasiveness assessments of alien species is to contribute to objectifying the discussion on alien species that is often emotional, sometimes polemical and without disclosing the assessment criteria or intentions of use. To do this, two aspects must be taken into account:

1) Alien species contribute less to the services of ecosystems due to the lack of evolutionary-ecological adaptation mechanisms. There are fewer interactions in biocenoses dominated by alien species (so neophytes generally offer less habitat for native insect species, especially for specialized, often rare and endangered species, so that, for example, the species diversity in a beech forest is higher than in a Douglas fir forest, GOSSNER 2004). In direct comparison, alien species therefore contribute little or no contribution to “species diversity”. It should be noted that the geographical spread of alien species generally leads to a unification of previously separate biocenoses and therefore to an overarching loss of biodiversity in ecosystems.

2) The few species that have been proven or potentially have further negative effects on the protected assets of nature conservation (= "ecological damage") that go beyond the immediate reduction in biodiversity and therefore cause or can cause problems from a nature conservation perspective (e.g. replacement of native species that threatens the population), are called invasive species. Their identification based on comprehensible criteria is the subject of the nature conservation invasiveness assessment.

The nature conservation requirement can be derived from both facts:*in areas where the goals of nature conservation are paramount*(Protected areas, compensatory and replacement measures, etc.)*, on****non-residents****Species are to be avoided in principle and that****invasive** *Species are not acceptable from a nature conservation perspective even with other requirements and usage goals*are. These two levels of evaluation are often not sufficiently separated, which leads to the general accusation that nature conservation “dogmatically rejects everything that is foreign”.

By specifically naming the problematic invasive species, the general discussion about alien species

(whether they are "good" or "bad", should be rejected, accepted or welcomed), which has been going on for a long time without any practical results, is intended to focus on those that are problematic from a nature conservation perspective , invasive species are focused on. The method of nature conservation invasiveness assessment is intended to be an understandable, clear and therefore easy-to-communicate instrument for
for practical nature conservation and for the normative-political discussion to create the basis for urgently needed practical measures.

The nature conservation invasiveness assessment is - analogous to the Red Lists of Endangered Species - a basis for nature conservation assessment and - also analogous - only names the "dangerous" species without making direct recommendations for action. By dividing the species into categories, it suggests fundamental options for action (e.g. measures against species on the “Black List – Management List” only in individual cases, increased monitoring of species on the “Grey List”) and only for species on the Action List that have not yet been widely used Immediate measures are recommended across the board to prevent further spread.

Their possible applications therefore go far beyond the narrowing of the discussion to “combat a species yes or no” or the listing of widespread species is not associated with a blanket recommendation to combat all of their occurrences. As experiences from other countries show, nature conservation invasiveness assessments of alien species are the basis for various technical, legal and political measures. They also serve to communicate and provide technical support for nature conservation recommendations and demands regarding invasive species, as the following conceivable application examples show:

- Consideration in care and development plans, e.g. differentiated treatment of

Occurrence of invasive species (earlier and more frequent mowing in areas where invasive neophytes occur in wet meadows, which deviates from the generally late and rare mowing dates, targeted management of their occurrence),

- Consideration in the designation of protected areas or in the associated regulations (e.g. ban on the release of species on the black list, regular monitoring of existing occurrences and mandatory countermeasures when they occur for the first time),
- Consideration in greening planning, e.g. of traffic routes, by landscape planners, landscape architects, gardening and (water) construction authorities, in forestry, etc.,
- Basis for rules of use in accordance with nature conservation (e.g. by horticulture or its producers, forestry and fishing industries), which can include the complete abandonment of species on the black list or measures for their safe use (e.g. cultivation of black locust outside of cities only with a sufficient safety distance). Dry
  biotopes such as rocks or poor grassland),
- Consideration in training and further education (e.g. in horticultural apprenticeships, in the studies of conservationists, landscape planners and architects),
- as a basic recommendation as to whether or under what conditions an authorization for the release of alien species in accordance with Section 40 Paragraph 4 of the German Federal Nature Conservation Act is justifiable by nature conservation authorities responsible under state law in their area,
- as a technical basis for possible legal trade restrictions (possession and marketing bans based on Section 54 Paragraph 4 BNatSchG),
- Increased consideration of the occurrence of invasive and potentially invasive species that are not yet widespread or not yet occurring in mapping, recording and monitoring programs (in order, for example, to help clarify their invasion potential),
- Increased research into these species (their biology, distribution and effective management measures) and into alternative uses (e.g. suitable replacement plants for species used in landscaping).

3 BASICS

3.1 Definitions and clarifications of terms

a) Alien species (Neobiota)

Alien species are animal, fungal or plant species that, with the direct or indirect involvement of humans, have reached an area outside their natural range and live or have lived there wild (CBD 2000, 2002, ESSL & RABITSCH 2002, KOWARIK2010).

Species are therefore alien even if they arrived in an area naturally, but from an area into which they were previously introduced by humans. Furthermore, for pragmatic reasons, all species that do not yet occur in an area are also considered alien here, so that we do not have to speak of “invasive species that are alien or do not yet occur in an area” in the following.

Note: The term “alien species” used in the methodology corresponds to the term “non-native species” used in the German BNatSchG.

b) Native species

All other species

- have their natural distribution or migratory area wholly or partly in the reference area or have had it in historical times or it
- have expanded into the reference area naturally, i.e. without removing a natural barrier to spread, or
- were introduced into the reference area before 1492 and have been preserved there since then (long-established naturalized species)

are considered native.

Since in Central Europe traditionally naturalized species that were introduced before 1492 are considered equal to native species, only species introduced after 1492 are referred to below as alien. However, historical documents do not always allow a clear classification, so in some cases this distinction will not be possible with certainty. When such a case is presented, an appropriate comment explaining the decision made in more detail should be provided.

Since the indirect involvement of humans is often difficult to prove (e.g. current climate change or the creation of new locations), this broad definition restricts species that have “naturally” expanded their

range into the reference area on their own and without removing a natural barrier to dispersal , hereinafter not considered as non-resident. Since the construction of waterways means overcoming barriers to dispersal, this means that “immigrant” species are alien (NEHRING 2005).

Both**BfN's nature conservation invasiveness assessments**Species and subspecies are taken into account, but not lower infraspecific taxa or regional origins. Because that**Be a busy area**for the BfN**the national borders of Germany**regional neobiota that are native to one part of the reference area and alien to another part are also not taken into account in the BfN's invasiveness assessments.

Note: The term "native species" used here differs from its use in the German BNatSchG only in terms of the point in time at which an alien species is considered native. In contrast to the time chosen here in 1492, according to the BNatSchG (Section 7 Paragraph 2 No. 7), a wild or naturalized species is considered to be after several generations
ons as native if it can survive as a population in the wild and without human help for several generations. This difference in definition has no impact

Consideration when classifying the invasiveness of a species; The only decisive factor here is the foreign origin.

c) Invasive species

Invasive species are alien species that endanger biodiversity (diversity of habitats, species and genes) in their new area (CBD 2000, 2002).

Note: In accordance with the meaning of the CBD (2000, 2002), the term “invasive” refers exclusively to threats to biological diversity. This also corresponds to the definition of “invasive” in the German BNatSchG (Section 7 Paragraph 2 No. 9, “invasive species: a species whose occurrence outside its natural distribution area represents a significant potential threat to the naturally occurring ecosystems, biotopes or species there.” "). This means that the threat or damage potential of an alien species is exclusively related to impacts relevant to nature conservation and not to other problems, such as economic or health problems. It should also be noted that, especially in science, a different use of the term invasion aimed at dispersal-biological parameters is often common (cf. the branch of science “invasion biology”) (e.g. RICHARDSON et al. 2000, PYŠEKet al. 2004).

The Asian longhorned beetle (*Anoplophora glabripennis*) infests healthy trees that appear and can cause them to die within a few years bring (© Bavarian State Institute for Agriculture).

3.2 List Categories

The tried and tested scheme of a three-part list system is followed here (black list / invasive species - gray list / potentially invasive species - white list / previously non-invasive species).

At the list category**Blacklist**There is a further division into three sub-lists, as for the species subsumed here with the greatest negative impacts, further differentiation according to action-relevant criteria (especially size of the area in the reference area, existence of suitable control measures) appears to make sense. A differentiation of the black list can also be found in other rating systems, whereby they generally only depend on the size of the populated area

Areas in the reference area act as a classification criterion (e.g. Belgian Black List, BRANQUART 2009).

Gray and White Listare less frequently subdivided internationally. In keeping with the precautionary principle, the Gray List is divided into two sub-lists in order to be able to include alien species on the Gray List even if - for example due to the spread just beginning - there are currently "only" indications of a threat to biodiversity , so real proof of the risk is still pending. Including the white list, this results in a total of 6 classes - on the one hand this still seems clear for an adequate classification of the range of alien species, but on the other hand it is differentiated enough. The number of around 5 classes has also proven and established itself in other assessment systems, such as the endangerment of native species (= Red Lists).

In principle, an alien species can only be assigned to a list category after a classification process. Before that, it should be considered unclassified in terms of its risk potential - this approach also corresponds to that of other nature conservation instruments such as red lists.

a) Blacklist of invasive species

This list category contains those alien species that are considered invasive because they are in the respective reference area***proven***is that they either***directly endanger native species***or***Changing living spaces in this way***, that this (***indirectly***) native species endangered.

These can include species living in the wild in the reference area as well as species missing from the reference area if, due to invasiveness in climatically or biogeographically similar areas, a future introduction into the reference area is likely to pose a threat (GENOVESIS& SHINE 2003).

The black list therefore contains those species that cause relevant problems from a nature conservation perspective and that therefore generally require action and regulation. Since the options for action are strongly determined by the biological characteristics of the species and the size of the populations or the size of the populated area in the reference area, the black list is divided into the following subcategories in order to present options for action in an easier to derive manner:

Blacklist – warning list:Contains (still) in the reference areanot wild[1] Alien species that are invasive in other climatically and naturally comparable regions or for which it is very likely that they will become invasive in the reference area and for which targeted preventive measures are therefore required to prevent their introduction (see also Section 40 Paragraph 1 BNatSchG).

Blacklist – Action List:Contains in the reference areawildinvasive species that occursmall-scaleare because they are usually at the beginning of the spread, and for thesuitable, promising control measuresare known. For these species, immediate, intensive and sustained control of all known occurrences is requiredmakes sense across the entire reference area, so that if it is possible to prevent its re-importation or introduction, there is a good chance of preventing further spread or even eliminating the species in the reference area. For the species in this group, the focus of action is therefore on early detection and immediate measures (see also Section 40 Paragraph 3 Sentence 1 BNatSchG).

[1] Those occurrences of alien species that occur on their own outside of human care and care over a longer period of time (longer than approximately 1 year) are classified as "wild". This term therefore includes both self-reproducing populations and non-reproducing individuals and populations (e.g. of red-eared sliders) of alien species. However, stocks in direct human care (e.g. fish species kept in fish ponds) or individuals that only appear in the wild for a short period of time (e.g. escaped pet birds) are excluded.

Blacklist – Management List:Contains in the reference areawildinvasive species, their occurrencesmall-scale are and for themno suitable, promising control measuresare known or theirOccurrences already on a large scaleare. Measures on these species are generally only useful locally and should aim to minimize the negative impact of these invasive species, for example on species, habitats or areas that are particularly worthy of protection (see also Section 40 Paragraph 3 Sentence 2 BNatSchG). In addition, monitoring makes sense, among other things with regard to their population development, distribution and the threat to biological diversity. Research activities are also required to develop new, promising methods of combating or at least improving control.

b) Gray list of potentially invasive species

Gray list – action list:This list category contains those alien species that are considered potentially invasive, as so far onlyreasonable assumptionspresent that they eitherdirectly endanger native species orChanging living spaces in this way, that this (indirectly) native species endangered. The negative effects cannot currently be definitively assessed due to insufficient knowledge, but are sufficient to justify measures.

Both wild species living in the reference area and alien species that are not (yet) wild can be included in this category. The latter are specifically marked as “missing in the reference area”.

Reasonable belief means that

- a) there are contradictory or insufficiently validated scientific studies, publications or expert assessments on negative nature conservation impacts in the reference area or ecologically similar areas.

  → *for wild and not (yet) wild species in the reference area*

- b) there are no scientific studies, publications or expert assessments on negative nature conservation impacts in the reference area and evidence from ecologically similar areas can only be transferred to the reference area to a limited extent.

  → *only for species that are not (yet) living in the wild in the reference area*

  → *When classifying, the presence of suitable habitats (in the reference area), biology and distribution dynamics (of the introduced species) must be taken into account*

Fulfillment of one of the stated criteria is sufficient.

In contrast to species on the Black List, there is no evidence for the species on the Gray List - Action List, but rather well-founded assumptions about negative effects. Therefore, on the one hand, monitoring of their population development and the threat they pose is necessary for these species (see also Section 40 Para. 2 BNatSchG), but on the other hand there is also a great need for research to develop and implement preventive measures.

Gray list – watch list:This list category contains those alien species for which there is evidence that, due to species-specific circumstances, they can either directly endanger native species or change habitats in such a way that this (indirectly) endangers native species.

Notes means that

- No negative nature conservation impacts have been proven in the reference area and from ecologically similar areas, but the ecological conditions in the reference area in conjunction with the biological properties of the species and the previous distribution dynamics provide indications of possible negative effects.

 for wild and not (yet) wild species in the reference area

 When classifying, the presence of suitable habitats (in the reference area), biology and distribution dynamics (of the introduced species) must be taken into account

This information, which must be taken into account for the classification in this list category in the additional biological ecological criteria, is also collected as information for all other species and is a general part of the short profile to be created during the classification, but is only relevant to the assessment in this case as criteria for the classification (for details see Chapter 4.2):

- Habitats: regular settlement of natural, semi-natural and other habitats that are technically valuable for nature conservation
- reproductive potential: The high reproductive potential of the species leads to large population sizes and densities under favorable environmental conditions.
- Spread potential: high dispersal potential of the species through dispersal mechanisms for long-distance dispersal or high probability of long-distance dispersal
- Distribution course: expansive spread in the recent past (5-10 years)
- Monopolization of resources: Species characteristics that favor a monopolization of resources (nutrients, space, etc.) (e.g. rapid growth, rapid increase in biomass); In addition, parasitic lifestyles must be taken into account.
- Promotion through climate change: the population density or the spread of the alien species is expected to be promoted by climate change (especially an increase in temperature).

Only species that meet more than half (at least 4 of the 6) listed criteria (assessment yes, high or expansive, see Chapters 4.1.2.9-2.14) are to be included in this list category.

This list category therefore contains those species for which there is evidence of invasion potential based solely on the species-specific criteria mentioned, i.e. where there are no relevant observations yet. For these types, the focus is on monitoring (see also Section 40 (2) BNatSchG) and research; further action does not appear to be justified due to the low level of knowledge.

c) White list of previously non-invasive species

This list category contains those alien species thatAccording to current knowledge, none Danger native species or habitats (GENOVESIS& SHINE 2003).

Alien species that have not been assessed should not be included in this list category, as placement in the White List requires a previous assessment.

3.3 Protected property

The central basis of every evaluation procedure in nature conservation is to identify, delineate and disclose the evaluation background, i.e. the content to be evaluated (KOWARIKet al. 2003). This procedure ensures that different people use the instrument with largely the same frame of reference and thus achieve consistent assessment results.

In this black list of invasive species, the evaluation background is derived from the internationally and nationally binding overall goals of nature conservation (conservation of biodiversity, CBD 1992). Accordingly, theThreat to native species from alien species defined here as the central evaluation background. The distinction between alien and native species was made in Chap. 3.1.

Therefore, possible negative effects of an alien species on another alien species are not the subject of the assessment (e.g. impairment of the horse chestnut, which was introduced as an ornamental tree, by the horse chestnut leaf miner, which probably comes from Asia*Cameraria ohridella*).

Any economic damage, negative health effects and aesthetic effects are not taken into account in the assessment.

The giant hogweed (*Heracleum mantegazzianum*) has ecological, economic and health effects (© R. May).

3.4 Ecological damage and damage threshold

The negative impacts of invasive species must exceed a damage threshold (KOWARIKet al. 2003). A quantitative determination of this damage threshold is necessary due to fundamental reservations (difficult parameterization, as this has to be tailored to taxonomic groups and different lifestyles) and due to the frequent lack of sufficiently precise data
not practical. Therefore, the damage threshold of the indicators used below is qualitatively determined as a threat to the existence of at least one native species in an area if AT THE SAME TIME it can be assumed that the colonization of further areas will result in the endangerment or extinction of these species in large parts of their distribution area, i.e. ultimately their Inclusion in the Red List or its upgrading in the Red List is to be expected.

> **As a damage threshold for inclusion in the black list, it is sufficient if the assessment criteria are only met locally AND if it can be assumed that these effects can also occur in other similar habitats. Thus, species that are at the beginning of a spread in the reference area are covered by the definition used here. Examples include the cabbage skunk, which until now only occurred locally in Germany in wet forests near streams (*Lysichiton americanus*) and the repeatedly exposed North American Ochsenfrosch (*Lithobates catesbeianus*).**

The possible threat to a native species results from its current population situation and the additional effective influence of an alien species. Other threat factors that may have a stronger impact on a species are not taken into account, i.e. the ADDITIONAL threat to a species from invasive species is assessed. An example: The stocks of brown trout (*Trout salmon*) have declined significantly in recent decades, primarily due to hydraulic engineering interventions. Today, however, the danger situation is reduced due to the stocking of the animals

demanding and sometimes superior to the competition rainbow trout (*Oncorhynchus mykiss*) increased - this increase in the risk situation must be assessed as part of the classification process.

3.5 Damage indicators

Negative impacts on biodiversity in the form of threats to native species can occur in various ways:

- Interspecific competition: Native species are endangered by competition from an alien species.
- Predation and herbivory: Native species are endangered by an alien predator or alien parasite.
- Hybridization: Genetic exchange between native and alien species in the wild occurs regularly, leads to fertile hybrids and thus endangers native species.
- Disease and organism transmission: The alien species transmits diseases or organisms (e.g. parasites); this puts native species at risk.
- Negative ecosystem impacts: Ecosystem properties (e.g. vegetation structures) or ecosystem processes (e.g. nutrient dynamics, succession processes) of a habitat are changed so fundamentally by an alien species that native species can be assumed to be at risk.

The latter criterion means that indirect effects of alien species are also recorded: If a habitat is markedly changed in its properties or ecosystem processes by the invasion of an alien species (e.g. eutrophication of semi-dry grassland by robinia, formation of dense coatings on hard substrates). in lakes by the triangular mussel), this is sufficient as a reason for endangering native species to create an alien species
to be listed as invasive.

3.6 Threats to biodiversity from invasive species

Based on the understanding of the term "non-native species" (Section 3.1), the underlying protected area of "native species" (Sections 3.1 and 3.3), their threat as a damage threshold (Section 3.4) and direct and indirect effects as a threat effect (Section. 3.5), the threat to biodiversity posed by invasive species can be defined as follows:

> **A threat to biodiversity from an alien species occurs if it endangers the existence of native species in an area or in several areas and if the alien species colonizes other comparable habitats, it endangers or causes the extinction of native species can be expected in large parts of their distribution area. A threat to biodiversity also exists when habitats are so affected by changes in ecosystem processes (e.g. succession) or ecosystem properties (e.g. habitat structures, nutrient cycles) by an alien species that it can be assumed that native species are present in their population (possibly . also or only across borders).**

3.7 Estimation of the risk of invasiveness based on findings from similar areas

The assessment of the risk of invasiveness by transferring knowledge from climatic and

Naturally similar areas represent an essential prerequisite for an ex ante assessment of alien species that are (still) missing in the reference area or are only beginning to spread. The "*invades elsewhere*"criterion is one of the most important and most suitable for carrying out predictive risk assessments (PYŠEK& RICHARDSON 2007).

Climatically and naturally similar areas are particularly regions with a nemoral (= winter cold, humid temperatures) climate (Zonobiome VI sensu WALTER & BRECKLE 1991) to be taken into account:

- Temperate Europe outside the actual reference area, bounded in the south by the Mediterranean and in the north by the Arctic region
- Eastern and parts of western North America
- East Asia, particularly temperate regions of China, Japan and Korea

Other areas with more deviating climatic conditions should only be taken into account in justified special cases.

The assessment of the risk of invasiveness by transferring knowledge from similar areas must always

be carried out on a case-by-case basis, i.e. a risk cannot be “automatically” assumed for all species from similar areas. It particularly requires a critical assessment of the literature, relevant databases, Internet sites and specialist books, etc., to be carried out by experts.

3.8 Basics for and assurance of classification

The degree of certainty of the classification required by an assessment concept determines the amount of work involved in the classification and the reliability of the classification result achieved. It should be borne in mind that there is a negative connection between these two points - i.e. very high reliability requirements require excellent basic data on the individual criteria and thus intensive data research. The consideration
numerous aspects in the classification methodology is therefore very resource-intensive.

The path chosen here avoids both possible extremes, but places emphasis on comprehensible (i.e. documented) and technically sound classifications.

The basic data for classification can be classified as follows:

- Scientific studies or publications
- Expert assessments

Literature-based statements should be made by examining publications of the original studies (primary literature); Secondary quotations should only be used as evidence in exceptional cases due to inaccuracies or unrecognizable interpretations that cannot be ruled out. In particular, links to profiles and databases available on the Internet should be provided as additional information. The references to the basic data must be stated in the comments field in the classification criteria.

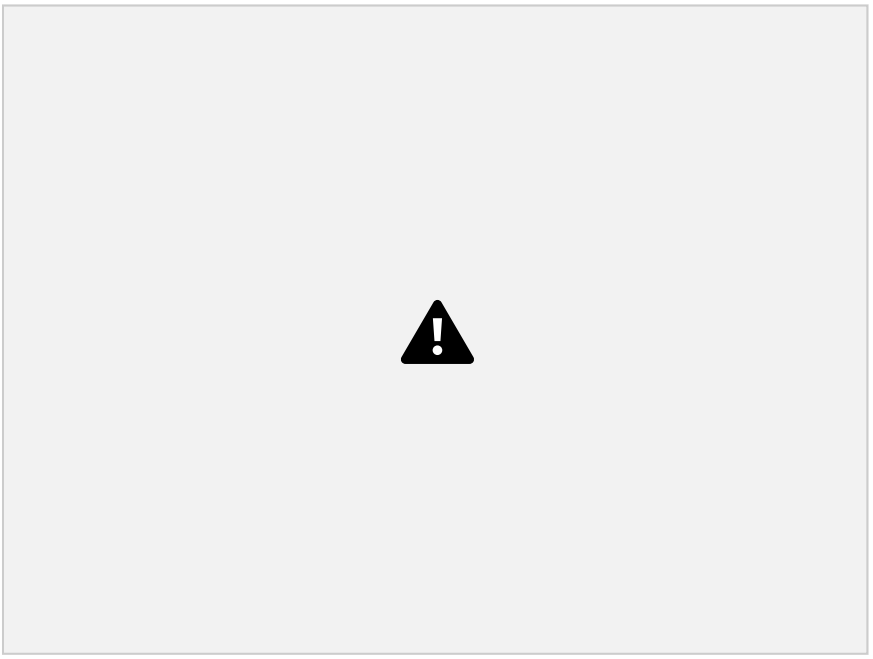
The basic data refers to

- the reference area or part of the reference area or
- Climatically and naturally similar areas (especially if there is no information from the reference area; Chapter 3.7)

Classification into different list categories requires different levels of certainty in the classification. For classification on the black or white list, there must be direct or no negative effects on native species or fundamental changes to habitats or ecosystem processes or ecosystem properties**proven**be (e.g. through literature, experts
knowledge) (Chapter 3.2). For inclusion in the Gray List - Action List, the existence is required**be-**

founded assumptions The existence of negative effects is sufficient for inclusion in the Gray List - Observation List, which is primarily based on the biology of the species**Clues**sufficient (Section 3.2).

An important element to be taken into account when assessing the future impacts of alien species is the "risk", which consists of the size of the possible negative impacts (amount of damage) and the uncertainty of the forecast (probability of occurrence) (KOWARIKet al. 2003). Despite intensive research, an exact ex ante classification of the future impacts of alien species is impossible (e.g. WILLIAMSON1996, KOWARIK2010). Therefore, every classification methodology has a certain a priori probability of error when assessing future impacts, which is further increased by insufficient basic data. The assessment method integrates this uncertainty by including alien species in the gray list that are insufficiently known regarding their negative impact on biodiversity. This also corresponds to the idea of the precautionary principle of the CBD (2000, 2002).



The North American bullfrog (*Lithobates catesbeianus*) endangers native ones Amphibians (© H. Laufer).

3.9 Prognostic classification based on species characteristics

A key research direction in invasion biology is dedicated to the identification of species characteristics that determine the invasion potential of species (HAYES & BARRY 2008, PYŠEK& RICHARDSON 2007, MOLESet al. 2008, KOWARIK2010).

Properties that enable rapid colonization and spread are generally considered to be characteristic of alien species. These are primarily a short life cycle, rapid growth, high reproductive potential, polyphagy, high genetic variability or low susceptibility to inbreeding depression (e.g. after a genetic "bottle-neck" of the population/species, GNO TERet al. 2002) and a broad ecological amplitude (JOWNER1988, KOWARIK2010, WILLIAMSON1996). However, under certain conditions, species with very different characteristics can also migrate successfully into new habitats. This is how they distribute according to KOWARIK(2010) found problematic neophytes in Germany to affect all forms of life, although woody

ze and geophytes (this includes many tall perennials with underground survival organs) are overrepresented.

There are also positive correlations between invasion success and the frequency of the species in its original range and the size of this range. Species that are common and widespread in their area of origin are generally more successful invasive species than rare species.

In addition to these species characteristics, the properties of the colonized biocenoses (communities, ecological niches), abiotic parameters and the number of individuals or reproductive units brought into a new area ("propagule pressure") are also seen as determining factors of a successful invasion (WILLIAMSON1996, NEHRING 2006, PYŠEK& RICHARDSON 2007). Human activities and socio-economic factors therefore play a decisive role (PYŠEKet al. 2010). In this way, the success of the spread of ornamental plants can be measured with their repeated and long-term planting (secondary carry-overs sensu KOWARIK2010), i.e. their popularity, sometimes even their price (DEHEN-SCHMUTZ et al. 2007) explain.

Thus, the effects of species characteristics are context, habitat and invasion phase dependent (PYŠEK& RICHARDSON 2007, REJMANEKet al. 2007, MOLESet al. 2008). In addition, individual species

characteristics are not per se conducive to invasion; rather, the combination of different characteristics is crucial. It should be noted that individual species characteristics can have a beneficial effect in one invasion phase, but a neutral or even negative effect in another (PYŠEK& RICHARDSON 2007). This means that only limited predictions about their invasion potential can be derived from species characteristics (KOWARIK2010, REJMANEKet al. 2007).

However, based on the analysis of the observed invasion behavior of species in a taxonomic group, species characteristics that contribute to the success of the invasion can subsequently be identified; However, these are often only valid for small taxonomic groups (e.g.*Pinus*, REJMANEK& RICHARDSON 1996).

In this concept, species characteristics are therefore only used as classification criteria for classification in the Gray List - Observation List (Section 3.2).

3.10 Management measures

Management measures against invasive species can be carried out using different methods (mechanical, biological, chemical), different objectives (elimination of the species, prevention of further spread, significant reduction in population size) and different geographical extent (for a small area, a region or an entire state) take place. As part of the assessment process, brief information on suitable methods and objectives is given below, which, however, does not replace a comprehensive concept for each individual invasive species.

The feasibility of management measures depends largely on species characteristics (life cycle, dispersal potential, etc.), the availability of suitable methods that can be implemented with reasonable effort, and the natural conditions on site.

When differentiating whether a blacklisted species already occurring in the reference area should be included in the action or management list, the existence of suitable species is important**Take immediate action**essential. Emergency measures aim to completely eliminate all deposits in a specific area. Whether emergency measures make sense depends on the possibility of complete elimination of the alien species or at least significant and lasting reduction in the entire reference area, the possibility of preventing re-importation or introduction and the availability of suitable techniques for emergency measures that can be carried out with reasonable effort can be implemented (Section 4.1.2). Since complete elimination or significant and permanent suppression depends on the frequency and distribution of the species in the reference area, it is only practicable for species that have previously been distributed over a small area in the reference area (Section 4.1.2).

In the case of species that are widespread over a large area, there can usually only be a target in limited areas

(such as nature reserves).**Measures**to eliminate them or to significantly reduce their population density, i.e. to reduce their effects in individual cases.

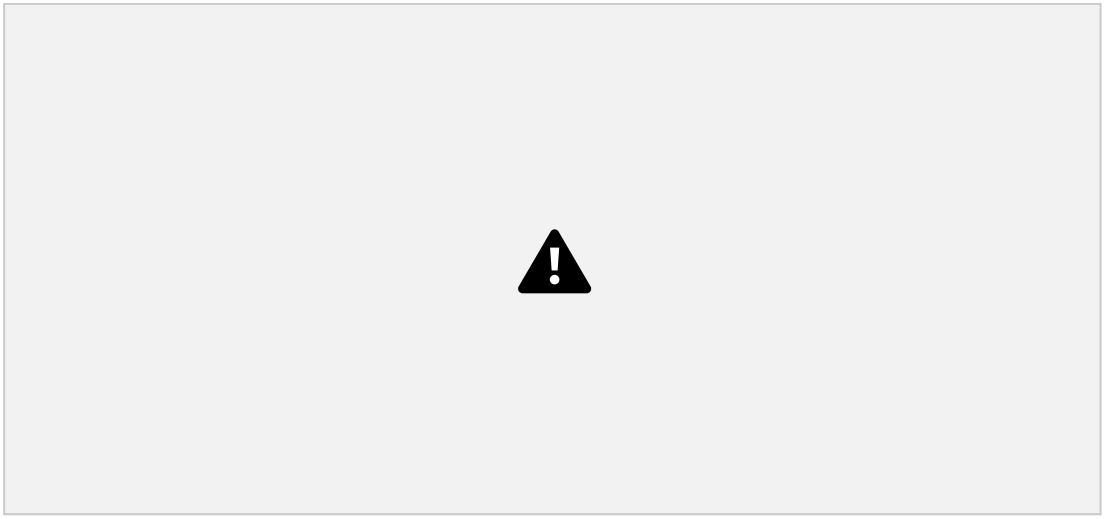
3.11 Temporal validity and presentation of invasiveness assessments

Due to advances in knowledge, but also because of the changing distribution and impacts of alien species, the classifications must be reviewed and adjusted at regular intervals (GENOVESIS& SHINE 2003).

There are basically two options available for this:

- A selective reassessment can be carried out when new knowledge emerges on individual species, for which a dynamic (web-based) presentation is particularly suitable. This approach has the fundamental advantage that the classification is up-to-date; a possible disadvantage can be that it is more difficult to communicate.
- In any case – similar to the red lists – the classification of all species should be subjected to a critical review at certain intervals. It is recommended that a complete update of the entire classification be carried out at intervals of around 10 years. In Central Europe, the threat situation of native species in national red lists is also reviewed approximately every decade and this interval has proven to be effective.

Which of the two options for revision is ultimately preferred (or whether a combination of both options is chosen) must be decided by weighing up the advantages and disadvantages. If preference is given to dynamic updating, the nature conservation invasiveness assessments should definitely be fully accessible on the Internet so that updates can be made quickly available to the public. When updating at longer intervals, the chosen method of a printed version of the nature conservation invasiveness assessments is also a well-suited presentation option.



The large-flowered hay herb, which has so far only appeared locally in Germany (*Ludwigia grandiflora*) has formed a mass population in an oxbow lake that needs to be completely eliminated (© S. Nehring).

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4.1.1.3 *Status*

Scaling:

- *Established*: The alien species has survived in the wild in the reference area for a longer period of time and reproduces independently.
- *Inconstant*: The alien species occurs wild in the reference area, but it does not meet at least one of the two criteria for established (wild occurrence over a longer period of time, independent reproduction). A single record of the species within the last 25 years in the wild (e.g. in captivity refugees) is sufficient, although the species must occur over a longer period of time (longer than 1 year). If there are clear indications that the unstable occurrence in the reference area has expired or been eliminated, the appropriate scaling should be selected.
- *Missing*: The alien species does not occur in the reference area or only does not occur wildly.
- *Missing - Extinguished*: The alien species appeared over a longer period of time (longer than approximately 1 year) and disappeared from the reference area through natural or unknown means.
- *Missing - Eliminated*: The alien species was eliminated from the reference area due to human influence.
- *Unknown*: It is certain that the species has occurred in the wild in the reference area, but it does not meet the criteria for "Established" or "Unstable" and it is uncertain whether the population of this species in the reference area has been completely eliminated or has become extinct.

Comment: According to LUDWIGet al. (2006) those alien species that meet both a time criterion and a population biology criterion:

Time criterion:

● Survival of the species in the reference area for at least 25 years

or

● a shorter period of time if this (in conjunction with the biology of the species) ensures continued survival in the reference area

or

● Spread across climatically different areas that represent the climatic range of a region in a shorter period of time (replacement of time by space)

and population biology criterion:

● Formation of independently viable and reproducible units (from sex cells, diaspores or rameta) in two successions (i.e. three generations).

InconstantAlien species are opposed if they do not meet the above criteria for established alien species in at least one point.

Notice: The link between a temporal and a population biological criterion is intended to prevent apparent naturalizations from being taken into account, since the addition of a longer period of time requires the survival of extreme events (e.g. very cold winters) (ESSL & RABITSCH 2002, KOWARIK2010, LUDWIGet al. 2006). In the international scientific literature, however, only one factor is often taken into account, namely the development of self-sustaining populations (RICHARDSON et al. 2000, F.ALK-PIF YOU ETERet al. 2006). Auch PYŠEKet al. (2004) consider species to be established if they maintain self-sustaining populations for at least 10 years.

Note 1: Those occurrences of alien species that occur outside of the area are considered “wild”.

semi-human care and care by one's own efforts over a longer period of time (longer than about 1 year). This term therefore includes both self-reproducing populations and non-reproducing individuals and populations (e.g. of red-eared sliders) of alien species. However, stocks in direct human care (e.g. fish species kept in fish ponds) or individuals that only appear in the wild for a short period of time (e.g. escaped pet birds) are excluded.

Note 2: For the status information "Missing - Expired", "Missing - Eliminated" and "Unknown", the level

of knowledge must be stated as a comment.

Note 3: If the status is "Missing", individuals that are not living in the wild in the reference area (e.g. in botanical gardens), their individuals, which may only appear in the wild for a short period of time, and their import vector(s) must be stated as a comment.

Note 4: For all status information (except "Missing"), the general information (method of introduction, import vectors, initial introduction, initial proof) must be listed.

Note 5: The assessment as "unstable" usually requires the specification "Small-area" in the additional criterion "Current distribution". If there is evidence of a threat to biodiversity for such species ("Yes"), the classification is carried out as for species with the status "Established", i.e. this combination results in the Black List-Action List category if "immediate measures" are present, otherwise the Category Blacklist Management List.

Note 6: The rating as "Unknown" results in the indication "Unknown" in the current distribution. If there is evidence of a threat to biodiversity for such species ("Yes"), the classification is carried out as for species with the status "Missing", i.e. this combination results in the Black List-Warning List category.

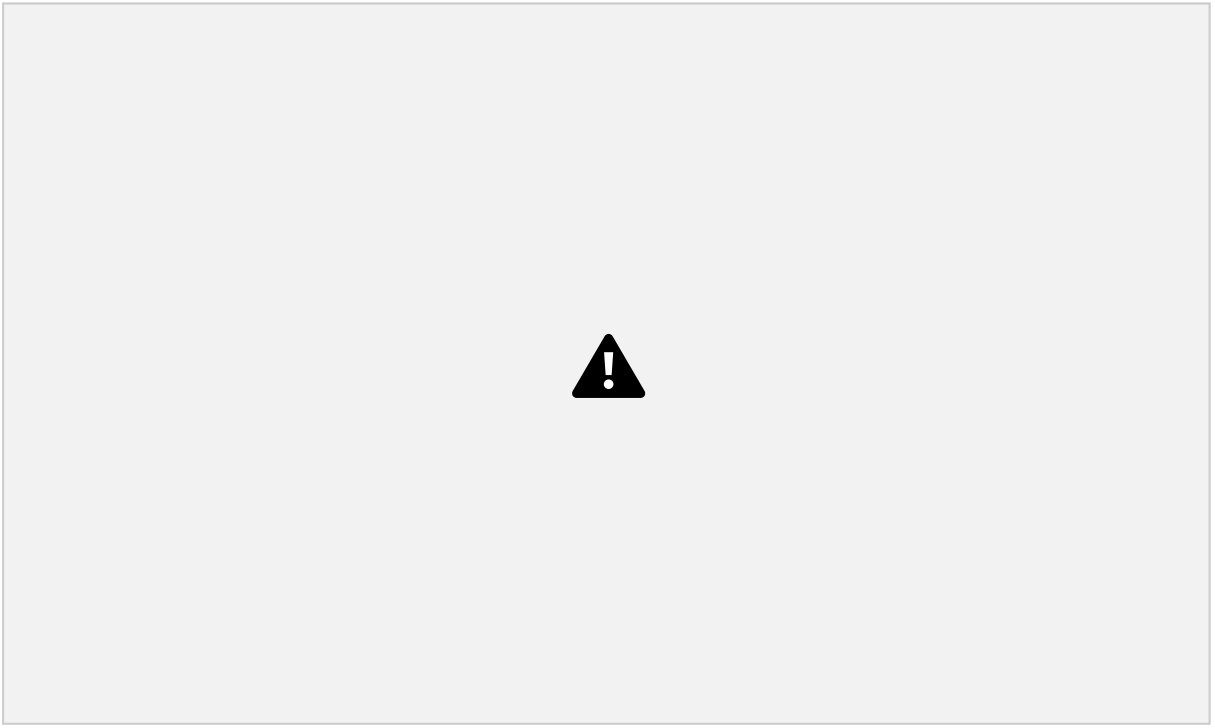
4.1.1.4 *Original area*

Reference list (large geographical regions according to TDWG standard, World Geographical Scheme for Recording Plant Distributions, 2nd Edition; http://www.tdwg.org/standards/109/):

0 NOT A NATURAL AREA	**3 TEMPERATES ASIA** 30 Siberia 31 Russian Far East 32 Central Asia 33 Caucasus 34 Westasien 35 Arabian Peninsula 36 China 37 Mongolia 38 East Asia	**7 NORTH AMERICA** 70 American Subarktisches 71 Western Canada 72 Eastern Canada 73 Northwestern U.S.A. 74 Central Northern U.S.A. 75 Northeast U.S.A. 76 Southwestern U.S.A. 77 Central Southern U.S.A. 78 Southeastern U.S.A. 79 Mexico
1 EUROPE 10 Northern Europe 11 Central Europe 12 Southwest Europe 13 Southeastern Europe 14 Eastern Europe	**4 TROPICAL ASIA** 40 Indian subcontinent 41 Indochina 42 Malaysia 43 Papuan Asia	**8 SOUTH AMERICA** 80 Central America 81 Caribbean 82 Northern South America 83 Western South America 84 Brazil 85 Southern South America
2 AFRICA 20 North Africa 21 Macronesia 22 Tropical West Africa 23 Central Tropical Africa 24 Northeast Tropical Africa 25 Tropical East Africa 26 Tropical South Africa 27 South Africa 28 Mid-Atlantic Ocean 29 Western Indian Ocean	**5 AUSTRALIAN GLASSES** 50 Australia 51 New Zealand	
	6 PACIFIC 60 Southwest Pacific 61 Central South Pacific 62 Northwest Pacific 63 Central North Pacific	**9 ANTARCTIC** 90 Subantarctic Islands 91 Antarctica **100 UNKNOWN**

Note 1: The statement "No natural area" applies to hybridogenic species. The origin of the hybridogenic species must be stated as a comment.

Note 2: If "Unknown" is specified, the level of knowledge must be stated as a comment.



4.1.1.5 *Method of introduction*

Scaling:

- *Intentionally*: The alien species is/was intentionally introduced into the reference area as a result of human activities**or**has reached the reference area on its own from an adjacent deposit that was due to intentional importation.
- *Unintentionally*: The alien species is/was unintentionally introduced into the reference area as a result of human activities**or**reached the reference area on its own from an adjacent deposit that was due to unintentional importation.
- Unknown

Note 1: This information usually describes the method of initial introduction into the reference area.

Note 2: Special case of hybridization: An alien species that was created by artificial hybridization (e.g. in the laboratory, through crossing experiments) in the reference area or was created in the same way in an adjacent area and has reached the reference area on its own is considered to be " introduced "intentionally". An alien species produced by natural hybridization
The hybridization of non-native species with native ones or through natural hybridization of non-native species in the reference area (spontaneous hybrid) or which arose in the same way in an adjacent area and reached the reference area on its own is considered to be introduced "unintentionally".

Note 3: No information is provided for alien species that have the status “missing” in the reference area.

4.1.1.6 *Import vectors*

Intentional import vector reference list:

Ansalbung	hunt
Aquaculture	Landscaping (e.g. recultivation, erosion protection)
Biological control	Agriculture
Botanical Garden	Sport

fishing	Animal trade (including aquaristics)
forestry	Other intentional import routes (e.g. research)
horticulture	Unknown

Reference list for accidental importation vectors:

Aquaculture	Animal trade (including aquaristics)
Ballastwasser	Transportation along roads
Biovectors (host/parasite/symbiont)	Transportation along railways
Botanical Garden	Transport along ports
fishing	Transport along waterways (including canals)
forestry	Transport by air freight (transcontinental)
Feed, bird food	Transport of goods (excluding those mentioned above)
horticulture	Contamination of seeds etc.
Captivity refugees (including fur trade)	Contamination of soil etc.
Heu, Stroh	storage pests
hunt	To want
Agriculture	Other unintentional import routes (e.g. sports)
Ship's hull	Unknown
Spontanhybride	

Note 1: The first named import vector describes the circumstances of the initial introduction; any later (other) import vectors are listed below. The structure of the vectors is mainly based on the classification developed in the DAISIE project (www.europe-aliens.org).

Note 2: No information is provided for alien species that have the status “missing” in the reference area.

4.1.1.7 *Initial contribution*

Scaling:

- *Year information*(decade, century): Time of first introduction of non-wild individuals of the alien species into the reference area.
- Unknown

Comment: If available and important, provide the original time from the source. To document the history of the contribution, additional time information from different regions can be cited as examples.

Note 1: This information can usually only be provided for intentionally introduced alien species. As a result of "time-lag" phenomena, the point in time can be well before the first detection of wild individuals.

Note 2: In order to simplify and standardize statistical evaluations (e.g. for information on "time lag") and to make them transparent to the public, the following scaling rules apply when referencing a wide range of time information in the sources (examples

original information from the literature in quotation marks):

"1884" = 1884

"between 1880 and 1884" = 1880-1884

"around 1880" = around 1880 (or if necessary for statistical evaluations = 1878-1882) "beginning

or middle or end of the 1880s" = 1880-1882 or 1884-1886 or 1887-1889 "in the 1880s" =

1880-1889

"Beginning or middle or end of the 19th century." = 1800-1819 or 1840-1859 or 1880-1899

"in the 19th century." = 1800-1899

If applicable. other types of time information not considered here should be referenced in a similar manner. In the event of an imprecise indication of the first introduction (e.g. "19th century") and a more precise indication of the first record (e.g. "1887"), the indication of the first introduction must be narrowed down accordingly (e.g. 1800-1887). Adopting imprecise information such as "?" (= sometime before the source appeared), "before 1810" (= sometime before 1810) or "after 1810" (sometime after 1810; e.g. when submitting a provisional date that only applies generally to Europe, with the first introduction to Germany occurring at the same time or should have only taken place at a later point in time) should be avoided as far as possible, as they ultimately have no or only very limited informative value; In these cases, the research should be intensified after the initial introduction and, if necessary, after the initial verification in order to at least obtain a more or less long but clear period of time.

Note 3: No information is provided for alien species that have the status "missing" in the reference area.

4.1.1.8 *Initial proof*

Scaling:

- *Year information*(Decade, Century): First record of a wild individual in the reference area.
- Unknown

Comment: If available and important, provide the original time from the source. To document the history of the spread, additional time information from different regions can be cited as examples.

Note 1: For intentionally introduced alien species, the timing may be well after importation and individuals planted or captive under human care as a result of "time-lag" phenomena.

Note 2: The time of the first intentional release of an individual then living in the wild also counts as the first proof.

Note 3: To reference times in the sources for scaling, see the corresponding note under "Initial introduction". In the event of an imprecise information for the first record (e.g. "19th century") and a more precise information for the first introduction (e.g. "1842"), the information for the first record must be narrowed down accordingly (e.g. 1842-1899). Especially for species that were most likely already present in the wild in the reference area before 1492, but no corresponding evidence can be found, "Before 1492" must be stated as the initial evidence. A comment must then be added as to why the species was probably already living in the wild in Germany before 1492.

4.1.2 Main and additional criteria

A) Main criterion – threat to biodiversity

For the interpretation of the threat to biodiversity, the damage thresholds and the security of the classification for the classification criteria listed below, see Chapter. 3.3-3.8.

4.1.2.1 *Interspecific competition*

Scaling:

- *And*: Interspecific competition from the alien species endangers native species.
- *Reasonable assumption*: There are well-founded assumptions that the alien species endangers native species through interspecific competition.
- *No*: Interspecific competition by the alien species does not endanger native species.
- *Unknown*: An assessment of the threat to biodiversity caused by interspecific competition from the alien species is not possible.

Comment: Indication of the area from which the data comes (reference area, ecologically similar areas).

4.1.2.2 *Predation and herbivory*

Scaling:

- *And*: Predation or herbivory by the alien species endangers native species.
- *Reasonable assumption*: There are well-founded assumptions that the alien species endangers native species through predation or herbivory.
- *No*: Predation or herbivory by the alien species does not endanger native species.
- *Unknown*: An assessment of the threat to biodiversity caused by predation and herbivory by the alien species is not possible.
- Not rated

Comment: Indication of the area from which the data comes (reference area, ecologically similar areas).

Note 1: Predation or herbivory also includes feeding by parasites that reside temporarily or permanently on or in the organisms of another animal or plant species in order to obtain food from them; In some cases they also kill their host after development.

Note 2: If there is no predation or herbivory (e.g. almost all plants), the statement "Not assessed" is made.

4.1.2.3 *Hybridization*

Scaling:

- *And*: A genetic exchange between native and alien species in the wild occurs regularly, leads to fertile hybrids and thus endangers native species.
- *Reasonable assumption*: Genetic exchange between native and alien species with the formation of fertile hybrids has been proven under laboratory conditions or through cross-breeding experiments or occurs irregularly in the wild.
- *No*: A genetic exchange between native and alien species with the formation of fertile hybrids does not take place in the wild. There is currently no known threat to native species.
- *Unknown*: There are native representatives of the genus in the reference area for which genetic exchange with the alien species is not known or there are native representatives of the genus or other native species for which genetic exchange with the alien species is only possible with education non-fertile hybrids in the laboratory or in the wild is; It is unknown whether native species are at risk.

Comment: Indication of the area from which the data comes (reference area, ecologically similar areas).

Note: If hybridization of an alien species with a native species results in non-fertile hybrids, this is only significant from a population biology perspective if it occurs on a large scale (e.g. this leads to a reduced effective population size). However, since hybridization with non-fertile offspring 1) usually only occurs rarely (relatively large genetic distance between the El
tern species) and 2) does not lead to any genetic introgression into the native species, these cases are considered to be below the damage threshold and rated as "Unknown" with regard to a threat to biodiversity.

4.1.2.4 *Disease and organism transmission*

Scaling:

- *And*: The alien species transmits diseases or organisms (e.g. parasites); this puts native species at risk.
- *Reasonable assumption*: The alien species transmits diseases or organisms (e.g. parasites); However, there are only reasonable assumptions that this will endanger native species.
- *No*: The alien species does not transmit diseases or organisms (e.g. parasites), or it transmits diseases or organisms (e.g. parasites); However, this does not endanger native species.
- *Unknown*: It is not possible to assess the threat to biodiversity caused by the transmission of diseases and organisms.

Comment: Indication of the area from which the data comes (reference area, ecologically similar areas).

4.1.2.5 *Negative ecosystem impacts*

Scaling:

- *And*: The alien species causes negative ecosystem impacts that endanger native species.
- *Reasonable assumption*: There are reasonable assumptions that the alien species is causing negative ecosystem impacts, leading to endangerment of native species.
- *No*: The alien species does not cause any negative ecosystem impacts

lead to endangerment of native species.

- *Unknown*: An assessment of the threat to biodiversity due to negative ecosystem impacts caused by the alien species is not possible.

Comment: Indication of the area from which the data comes (reference area, ecologically similar areas).

Reference list:

Influences on erosion	Change in food relationships
Influences on soil formation	Change in succession processes
Influences on nutrient dynamics and soil chemistry	Change in vegetation structures
Influences on sedimentation	Change in the water balance
Influences on vegetation dynamics	Reduction of the radiation balance
Decoupling of host-parasite or mutualistic relationships	

Note: The selection of terms from the reference list is provided as additional information.

B) Additional criteria

4.1.2.6 *Current distribution*

Scaling:

- *Missing*: The alien species does not occur wild in the reference area.
- *Small-scale*: The alien species has one or more occurrences (areas) in the reference area, some of which are clearly separated from each other, but which do not account for more than around 1% of the total area.
- *Spacious*: The alien species has numerous occurrences in the reference area, usually extending over a large area.
- *Unknown*: The alien species probably occurs wild in the reference area, but its distribution is unknown.

Note 1: In order to assess the size of the populated area in relation to the total area, an agreement on the potentially habitable area is required. Since land plants and seaweeds populate very different areas of the reference area and therefore have to be referred to different areas, the following agreements apply, as they also apply in the German Red Lists (cf. Ludwig et al. 2006):

- *For species that reproduce on land (= terrestrial species), the land area (mainland with islands) should be chosen as the reference area. This also applies to species that use marine areas to obtain food.*
- *For freshwater species with no connection to the sea, the total area of flowing and still water is chosen as the reference area.*
- *For marine organisms, only the sea area is set as a reference area. This also includes the Bodden, the Wadden Sea and the so-called exclusive economic zone (EEZ = "200 nautical mile zone").*
- *For species living in the sea and freshwater, the reference area includes flowing and still waters and marine areas.*

Note 2: The indication "Unknown" is usually only given for species that have the status "Unknown". Exceptions need to be explained in more detail.

Note 3: In the case of species missing in the reference area and species with an unknown distribution, a brief statement of the alien occurrences for immediately adjacent areas or Europe and possibly beyond should be provided.

4.1.2.7 *Immediate measures*

As part of the classification process, no detailed recommendations are made on suitable management measures for individual alien species. Only in order to specify the objective of management measures for the entire reference area, it is assessed whether immediate measures with the aim of complete elimination or at least massive and permanent reduction are available for alien species that are missing in the reference area or for alien species that are only widespread in small areas (Section 3.10). For established invasive species, this serves to differentiate between the black list categories "Action List" and "Management List" (Section 4.2).

Scaling:

- *Available*: Suitable techniques for emergency measures are known for the alien species, the implementation of which can be implemented with the aim of complete elimination with

reasonable effort and the re-importation or introduction of the species into the reference area must be largely prevented.

- *Missing*: No suitable, promising techniques for emergency measures are known for the alien species or their implementation is not possible with a reasonable expenditure of resources or the massive re-importation or introduction of the species into the reference area cannot be prevented.
- *Unknown*: A well-founded assessment of suitable, promising techniques for immediate measures is not possible (insufficient or contradictory data).

Since the distribution of newly emerging species and techniques for emergency measures can change quickly, the assessment of this criterion should also be adjusted immediately, for example if improved methods are available.

Comment: If available and important, state the area from which the data comes (reference area, ecologically similar areas).

Reference list:

Mechanical control of woody plants (ringing, pruning, etc.)	Changes in land use (grazing, mowing, etc.)
Mechanical control of herbaceous plants (pulling out, cutting out, etc.)	Biological control (introduction of biological opponents)
Mechanical control of animals (collecting (e.g. eggs), laying traps, hunting, etc.)	Prevention of intentional release (anointing, stocking of fish, etc.)
Chemical control (biocides, pheromones, etc.)	Other (e.g. non-trading, public relations)

Note: Information is only given for missing species and for alien species that are widespread in small areas.

4.1.2.8 *Measures*

As part of the classification process, no detailed recommendations are made on suitable management measures for individual alien species. Only in order to specify the objectives of management measures for the entire reference area, it is assessed whether measures are in place for large-scale alien species that prevent (re)importation or introduction or further spread or that reduce the effects of the spread (Section. 3.10). The information is for informational purposes only and is not included in the evaluation.

Scaling:

- *Available*: For the alien species, suitable techniques are known for measures whose implementation with the aim of preventing (re)importation or introduction or further spread or reducing the effects of the spread is possible with reasonable effort.
- *Missing*: No suitable, promising techniques for measures are known for the alien species or their implementation is not possible with a reasonable expenditure of resources or the massive (re)importation or introduction of the species into the reference area cannot be prevented.
- *Unknown*: A well-founded assessment of suitable, promising techniques for measures is not possible (insufficient or contradictory data).

Comment: If available and important, state the area from which the data comes (reference area, ecologically similar areas).

Reference list:

Mechanical control of woody plants (ringing, pruning, etc.)	Changes in land use (grazing, mowing, etc.)
Mechanical control of herbaceous plants (pulling out, cutting out, etc.)	Biological control (introduction of biological opponents)
Mechanical control of animals (collecting (e.g. eggs), laying traps, hunting, etc.)	Prevention of intentional release (anointing, stocking of fish, etc.)
Chemical control (biocides, pheromones, etc.)	Other (e.g. non-trading, public relations)

Note: This information is only given for alien species that are widespread over a large area.

C) Biological-ecological additional criteria

The information provided in this chapter only serves as additional classification criteria for classification on the Gray List – Watch List (Section 3.2). They are also collected as information for all other species and documented in the respective profile.

4.1.2.9 *Occurs in natural, semi-natural and other habitats that are valuable in terms of nature conservation*

Scaling:

- *And*: The alien species regularly inhabits natural, semi-natural and other habitats that are valuable for nature conservation.
- *No*: The alien species does not regularly colonize natural, semi-natural and other habitats that are valuable for nature conservation.
- Unknown

Comment: Indication of the area from which the data comes (reference area, ecologically similar areas).

*Note: Indication of the mainly populated habitats (e.g. by selecting from the reference list below). Natural, near-natural and other habitats that are valuable in terms of nature conservation are those that are classified as worthy of protection in the national red lists of endangered biotope types; This means that habitats that have been heavily anthropogenically modified (e.g. forests, urban habitats, intensively used agricultural areas) are excluded (*RSICK*et al. 2006,* ESSL *et al. 2002a). If there is any uncertainty about the assignment, the Red List of Biotope Types should be consulted.*

Reference list: Large biotope groups, modified according to the Red List of Austrian biotope types (ESSL et al. 2002b, 2005, 2008, TRAXLER et al. 2005), supplemented according to the Red List of Endangered Biotope Types in Germany (RSICKet al. 2006).

Natural, near-natural and other habitats that are valuable in terms of nature conservation	**Habitats remote from nature**
Natural and semi-natural inland waters including riparian areas	Inland waters that have been heavily modified by anthropogeny (e.g. canals, ditches)
Moors, swamps and springs	Intensive grassland
Natural sea coasts, dunes and coastal heaths	Fields, arable land, vineyards and ruderal fields
Marine habitats	Bushes and woody plants in the open

	landscape that have been heavily modified by anthropogeny
Dry, semi-dry and poor grassland	First
High mountain grasslands, cushioned meadows, rocky, rubble and scree meadows	Technical biotope types, settlement biotope types
Natural and anthropogenic dwarf shrub heaths	
Bushes and trees in the open landscape	
Forests and foothills	

4.1.2.10 *reproductive potential*

Scaling:

- *High*: The alien species is capable of achieving large population sizes and high population densities in a short period of time under favorable environmental conditions due to high reproduction rates.
- *Small amount*: The alien species is unable to achieve large population sizes and high population densities in a short period of time under favorable environmental conditions due to high reproduction rates.
- Unknown

Comment: The reproductive potential is assessed using technically appropriate, group-specific indicators and defined accounting rules.

List of indicators:

Indicator	**Reason**	**Threshold**
PLANT		
Hohe Diaspora production	Positive relationship between diaspore quantity and number of offspring	Evidence of more than 1000 diaspores produced per plant/ramet per year
Short-livedness	Higher reproduction rates in species with short life cycles	Annual oder bienne Art
Asexual reproduction (clonal growth)	Higher establishment potential in clonally growing species	Yes No
ANIMALS		
High number of litters/clutches, generations per year and/or early sexual maturity	Higher reproduction rate with higher number of offspring and/or earlier sexual maturity	More than one litter/clutch/generation per year and/or sexual maturity occurs within one year
Short-livedness	Higher reproduction rates in species with short life cycles	Life expectancy up to two years
Asexual reproduction (parthenogenesis, fragmentation)	Higher reproduction rate with asexual reproduction	Yes No

Billing rules:

- The assessment as “High” occurs if one of the indicators applies.
- The assessment as “low” occurs if none of the indicators apply and at the same time information on at least one indicator is available.
- The assessment as “Unknown” occurs if no information is available for any of the indicators.

Note 1: Findings from both the original area and secondary areas must be taken into account.

Note 2: Technical information on the indicators must be provided as comments.

4.1.2.11 *Spread potential*

Scaling:

- *High*: The alien species has dispersal mechanisms for long-distance dispersal or has a high probability of long-distance movement by humans and thus has a high potential for rapid spread.
- *Small amount*: The alien species has a low potential for rapid spread due to the lack of long-distance dispersal mechanisms and a low probability of long-distance movement by humans.
- Unknown

Comment: The assessment of the spread potential is carried out using technically appropriate, group-specific indicators and defined accounting rules.

List of indicators:

Indicator	Reason	Threshold
PLANT		
The species is commercially available (garden markets, nurseries, etc.)	High relevance of the repeated release or naturalization of ornamental plants for the spread	Yes No
The species is currently used commercially (energy crops, agriculture, forestry, etc.)	High relevance of economic use for spread (releases or rewilding)	Yes No
Anthropogenic long-distance spread (e.g. through motor vehicles, ships, trade goods, etc.)	Supraregional to intercontinental anthropogenic transfer of species	Yes No
Natural long-distance dispersal (through animals, wind or along rivers)	Rapid spread over long distances through natural long-distance dispersal	Yes No
ANIMALS		
The species is commercially available (pet stores, aquariums, terrariums, etc.)	High relevance of the abandonment or escape of pets for the spread	Yes No
The species is currently used commercially (aquaculture, fishing, hunting, biological control, research, etc.)	High relevance of economic use for the spread (releases or refugees)	Yes No
Anthropogenic long-distance dispersal (through motor vehicles, ships, trade goods, etc.)	Supraregional to intercontinental anthropogenic transfer of species	Yes No

Natural long-distance dispersal (the species is mobile and not very faithful to its location or is spread by other organisms)	High mobility in conjunction with low location loyalty indicates high dispersal ability; rapid spread over large distances through natural long-distance dispersal	Yes No

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Billing rules:

- The assessment as “High” occurs if one of the indicators applies.
- The assessment as “low” occurs if none of the indicators apply and at the same time information on at least one indicator is available.
- The assessment as “Unknown” occurs if no information is available for any of the indicators.

Note 1: Findings from both the original area and secondary areas must be taken into account.

Note 2: Technical information on the indicators must be provided as comments.

4.1.2.12 *Current spread pattern*

Scaling:

- *Expansive*: The alien species has recently (in the last 5-10 years) shown a strong spread in the reference area or in immediately adjacent areas.
- *Stable*: The alien species has shown little or no spread in the reference area or in immediately adjacent areas in the recent past (in the last approx. 5-10 years).
- *Going back*: The distribution of the alien species has recently declined (in the last 5-10 years) in the reference area or in immediately adjacent areas.
- Unknown

Comment: Indication of the area from which the data comes (reference area, immediately adjacent areas).

Note 1: The expansion of the populated area and population increases are taken into account, whereby one of these two points applies is sufficient.

Note 2: A clear distinction between species-specific spread and human-assisted population increases (particularly in the case of stocking measures) is sometimes difficult. It is therefore suggested that propagation should be understood in a “broader sense” and the circumstances should be explained in more detail in the comment field.

Note 3: For species that do not occur in the reference area or in immediately adjacent areas, the indication “Unknown” is always given. If necessary, the level of knowledge about more distant occurrences can be specified.

4.1.2.13 *Monopolization of resources*

Scaling:

- *And*: Dominance of species characteristics that favor a monopolization of resources (nutrients, space, etc.) (e.g. rapid growth, rapid increase in biomass); In addition, parasitic lifestyles must be taken into account.
- *No*: No dominance of species characteristics that favor a monopolization of resources (nutrients, space, etc.) (e.g. rapid growth, rapid increase in biomass); In addition, parasitic lifestyles must be taken into account.
- Unknown

4.1.2.14 *Promotion through climate change*

Scaling:

- *And*: The population density or the spread of the alien species is expected to be promoted by climate change (especially an increase in temperature).
- *No*: The population density or the spread of the alien species is unlikely to be promoted or even restricted by climate change (particularly an increase in temperature, possibly changes in precipitation).
- *Unknown*: A well-founded assessment of support from climate change is not possible (insufficient or contradictory data).

D) Additional information

4.1.2.15 *Negative economic impact*

The alien species causes significant negative economic impacts. Reference list:

Aquaculture	fruit growing
Structures	shipping
fishing	Animal trade
Fish farming	Animal breeding
forestry	tourism
horticulture	Traffic
Industry	Water management
hunt	Miscellaneous
Agriculture	

Comment: Indication of the area from which the data comes (reference area, ecologically similar areas).

4.1.2.16 *Positive economic impact*

The alien species causes significant positive economic impacts. Reference list:

Aquaculture	fruit growing
Structures	shipping
fishing	Animal trade
Fish farming	Animal breeding
forestry	tourism
horticulture	Traffic
Industry	Water management
hunt	Miscellaneous
Agriculture	

Comment: Indication of the area from which the data comes (reference area, ecologically similar areas).

4.1.2.17 *Negative health effects*

The alien species causes significant negative health effects in humans. Reference list:

Allergy triggers	risk of injury
Hygiene problem	Miscellaneous
pathogens	

Comment: Indication of the area from which the data comes (reference area, ecologically similar areas).

4.1.2.18 *Knowledge gaps and research needs*

For species on the Gray List, an entry is mandatory; in particular, studies are required to clarify invasiveness. For species on the White List, no entry is generally necessary unless the value level "Unknown" has been assigned for at least one criterion for endangering biodiversity. No yield is provided for species on the black list
taken if immediate measures or measures were rated as "missing" or "unknown" or if other important questions (e.g. taxonomy) need to be clarified.

4.1.3 Notes, sources, editing and checking

4.1.3.1 *Remarks*

Quote of the methodology used. If applicable. additional information on legal regulations as well as other important information and findings about the species that were not mentioned in any criterion.

4.1.3.2 *Sources*

Bibliographic information on the literature cited, naming of other sources and, if necessary, links to profiles and databases available on the Internet.

4.1.3.3 *Processing and testing*

Information about processor(s) and, optionally, information about examiner(s). Indication of the time at which processing or testing was completed; for subsequent update(s), additional information about the time of the (last) update.

4.2 Classification process

The overall classification is based on the combination of the individual criteria relevant to the classification, which leads to an assignment to a list category. There are two steps to distinguish:

I.) The assessment of the criterion “threat to biodiversity” (Section 4.1.2) is always necessary for the classification of an alien species. This criterion is made up of five sub-criteria that are combined to form one value. The worst value assigned in the sub-criteria is decisive for the overall evaluation.

The criterion is a threat to biodiversity

- *If at least one sub-criterion is rated “yes”, the overall classification is “yes” and the*

Alien species must be placed on the black list.

- *If at least one sub-criterion is classified as “reasonable assumption” and no sub-criterion is classified as “yes”, the overall classification is “reasonable assumption” and the alien species is to be included in the Gray List - Action List.*
- *at least one sub-criterion is classified as "unknown" and no sub-criterion is assessed as "yes" or "reasonable assumption", the overall classification is "Indications" and the additional biological-ecological criteria (Section 4.1.2) are to be used for the classification; The alien species must then be classified either in the Gray List - Observation List or in the White List.*
- *If each sub-criterion is classified as "no", the overall classification is "no" and the alien species is to be included in the white list.*

II.) Depending on the classification case, additional criteria must be used for the final list assignment of an alien species:

- For alien species that are included in the black list, the allocation to the partial lists is based on their distribution in the reference area and the existence of immediate measures: Missing species or species with an unknown distribution must be included in the black list - warning list. If immediate measures are in place for alien species occurring in small areas in the reference area, they must be included in the black list - action list; Otherwise, like the alien species that occur over large areas, they must be included in the black list - management list.
- For alien species for which there is evidence that they endanger biodiversity, additional biological-ecological criteria (Section 4.1.2) must be used for classification. If at least 4 of the 6 additional criteria listed are met (assessment "yes", "high" or "expansive"), the alien species must be included in the Gray List - Observation List, otherwise it must be included in the White List.

If possible, the classification should be carried out by several experts from the respective taxonomic group or should be finally checked by one expert in order to obtain the most reliable classification result possible.

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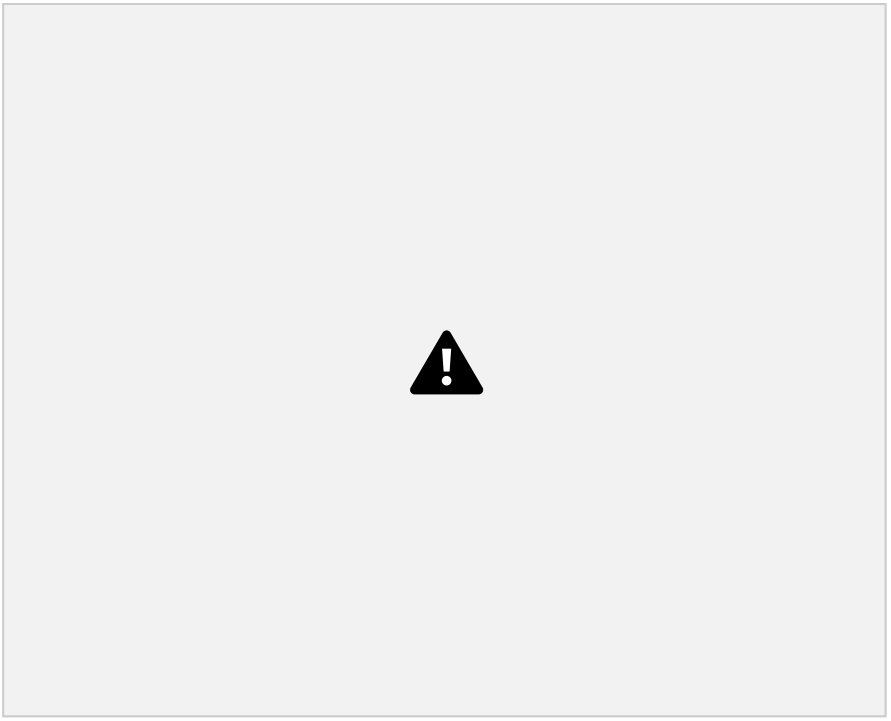
Graphical representation of the combination of the classification criteria described under I.) and II.) (without showing the additional biological-ecological criteria) and the resulting list assignment (see table for explanation of the footnotes):



Tabular representation of the combination of classification criteria described under I.) and II.) and the resulting list assignment:

Threat to biodiversity – overall classification	**Current distribution**	**Immediate measures**	**Biological ecological Additional criteria[a]**	**Listenkategorie**
proven[1]	Missing Unknown			Blacklist – warning list
	Small-scale	Available		Blacklist – Action List
		Missing Unknown		Blacklist – Management List
	Spacious			Blacklist – Management List

reasonable assumption[2]	Missing Unknown Small-scale Large-scale			Gray list – action list
Hints[3]	Missing Unknown Small-scale Large-scale		Min. 4 out of 6	Gray List – Watchlist
no danger[4]	Missing Unknown Small-scale Large-scale		Max 3 out of 6	White list
				White list

[1] At least one sub-criterion of the main criterion was assessed as “yes”;
[2] at least one sub-criterion of the main criterion was assessed as “reasonable assumption” and no sub-criterion was assessed as “yes”;[3] at least one sub-criterion of the main criterion is assessed as “unknown” and no sub-criterion is assessed as “yes” or “reasonable assumption” and at least 4 of 6 additional biological-ecological criteria are met;
[4] Each sub-criterion of the main criterion is assessed as “no” or at least one sub-criterion is assessed as “unknown” and a maximum of 3 of 6 additional biological-ecological criteria are met.

[a] An additional criterion is considered to be met if the assessment is “yes”, “high” or “expansive”.

4.3 Regional Management

The nature conservation invasiveness assessments of alien species for Germany published by the Federal Agency for Nature Conservation are based on the collaboration and expertise of numerous experts from home and abroad (see Chapter 5).**If the BfN has classified a non-native species as invasive in terms of nature conservation, this applies throughout Germany, i.e. also for each individual federal state.**However, differences may arise in the management measures required that should be taken for an alien species in the various federal states. Especially in the case of invasive species, which generally have great ecological plasticity and a high potential to spread, it must be assumed for technical and precautionary reasons that an occurrence in one federal state could also endanger ecosystems, biotopes or species in other parts of Germany. The creation of specific invasiveness lists of alien species at the level of the federal states (or other parts of Germany), which deviate from the federal classifications, would therefore not make sense from a nature conservation point of view and would also not correspond to the precautionary approach under Section 40 BNatSchG.

So it contains**Blacklist - Action List**of the BfN wild invasive species in Germany whose occurrence is small because they are generally at the beginning of their spread and for which suitable, promising control measures are known (see Chapter 3.2). These species require immediate, intensive and sustained control of all known occurrences
It makes sense throughout Germany, even if there is currently no direct threat to ecosystems, biotopes or species in individual occurrences due to natural conditions.

This management approach meets the requirements of Section 40 Paragraph 3 Sentence 1 BNatSchG, which stipulates that the responsible federal and state authorities must immediately take appropriate measures to eliminate newly emerging animals and plants of invasive species or to prevent their spread .

The**Blacklist - management list**of the BfN contains wild invasive species in Germany whose occurrence is either small-scale and for which no suitable, promising control measures are known or whose occurrence is already large-scale (see Chapter 3.2). Measures on these species generally only make sense locally to regionally and should aim to minimize the negative impact of these invasive

species, for example on species, habitats or areas that are particularly worthy of protection.

The decision to take action against invasive species on the Black List - Management List, and if so which ones, may therefore vary from occurrence to occurrence. If, for example, no measures are obviously necessary in a federal state due to natural conditions, it must always be checked for precautionary reasons whether an occurrence could also endanger ecosystems, biotopes or species in other parts of Germany, so that measures in the federal state could be justified . The following applies: A threat to the relevant ecosystems, biotopes or species in other areas of Germany applies if a spread/transfer from the populations in one federal state to the other areas is currently and/or expected in the future. This is fulfilled if, as part of the invasiveness assessment of the alien species, at least 2 of the 3 additional biological-ecological criteria listed below were assessed as follows:

- Spread potential (Section 4.1.2.11): High, whereby the threshold value for the indicators of anthropogenic and/or natural long-distance spread must be met with “Yes”.
- Current spread (Section 4.1.2.12): Expansive or unknown
- Funding through climate change (Section 4.1.2.14): Yes or unknown

This management approach meets the requirements of Section 40 Paragraph 3 Sentence 2 BNatSchG, which stipulates that the responsible federal and state authorities take measures for invasive species that are already widespread in order to prevent further spread and to reduce the effects.

to reduce the spread of the disease, provided that it has a chance of success and the success is not disproportionate to the effort required.

For the types of**Gray list (action list and watch list)**The BfN focuses on monitoring (see also Section 40 Para. 2 BNatSchG) and research (see Chapter 3.2). Especially for species on the Gray List - Action List, after examining the individual case, at least local removal measures may make sense for precautionary reasons.

The**White list**of the BfN contains those alien species that, according to the current state of knowledge, do not pose a threat to native species or habitats, so that no targeted action is necessary when they occur (see Chapter 3.2).

To date, the Federal Agency for Nature Conservation has available nature conservation invasiveness assessments for over 120 wild alien species in Germany, which are successively published by the BfN (see Chapter 4.4). In addition, the invasiveness of 42 alien species that currently do not occur in Germany has been assessed (RABITSCH et al. 2013). The BfN plans to carry out invasiveness assessments for further alien species, especially from taxonomic groups that have not yet been taken into account (e.g. fungi, insects, crabs, mollusks).**Collaboration in the preparation or review of nature conservation invasiveness assessments is possible at any time.**The BfN is available to answer any inquiries or queries.

If invasiveness assessments have been carried out for alien species that have not yet been processed by the BfN as part of third-party projects using the present methodology, the BfN will be happy to receive the assessment profiles. After clarifying technical questions if necessary, the BfN then includes these species in the list of assessed alien species for Germany.

It is important to review and adapt existing classifications at regular intervals due to advances in knowledge, but also because of the changing distribution and effects of alien species (see Chapter 3.11). The BfN is therefore happy to receive information when examining existing invasiveness classifications based on new ones or ones that have not yet been used
available findings, a revision of individual criteria etc. appears necessary.

4.4 Overview of existing nature conservation invasiveness assessments

Overview of existing nature conservation invasiveness assessments for alien species (neobiota) living wild in Germany by the Federal Agency for Nature Conservation (as of June 30, 2013):

group	Status	Number of wild neobiota species in Germany[1)]	Conservation invasiveness assessments[2)]	
			Invasive species	Potentially invasive species
Vascular Plant	Inconstant	432	37	35
Established		> 2.000		7
fish	Established	15	4	7
	Inconstant	78	2	3
Amphibians	Established	2	2	
	Inconstant	8	1	
Reptiles	Established	0	1	3
	Inconstant	14		
Birds	Established	18	2	8
	Inconstant	321		1
Mammals	Established	9	5	3
	Inconstant	13		

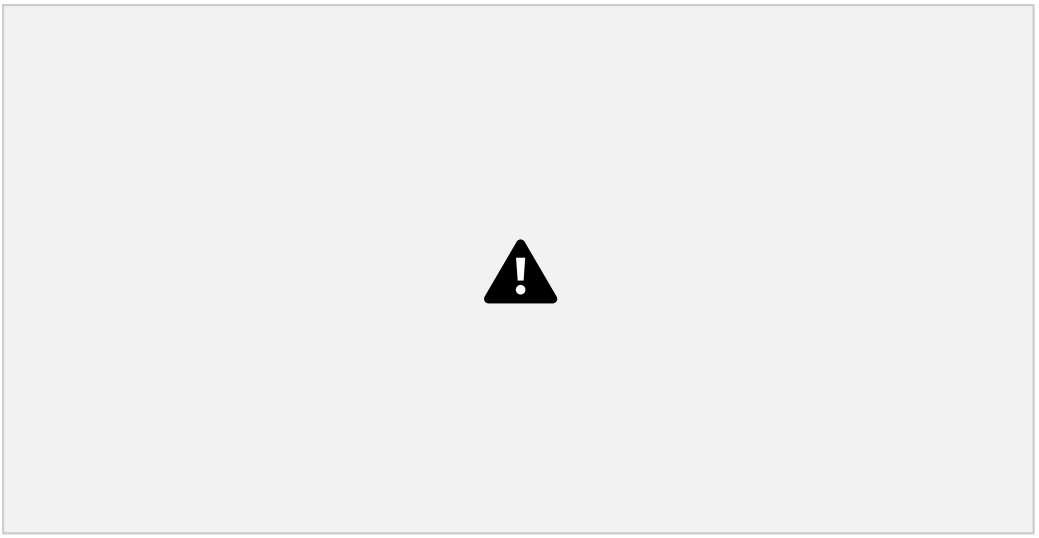
[1)] According to BFN (2012), [2)] According to NEHRING et al. (2010) and BFN (in preparation)

5 COORDINATION AND PREVIOUSLY ACTIVE EXPERTS

The creation or further development of the "methodology of nature conservation invasiveness assessment for alien species" as well as its previous application to plant and animal groups in collaboration with the Federal Agency for Nature Conservation for Germany and in collaboration with the Federal Environment Agency Vienna for Austria is under the coordination and a active collaboration from:

Coordination: For Germany: Stefan Nehring, Federal Agency for Nature Conservation Bonn For Austria: Franz Essl & Wolfgang Rabitsch, Federal Environment Agency Vienna

Active experts: Beate Alberternst, Hans-Günther Bauer, Franz Essl, Konstantin Etling, Olaf Geiter, Stephan Gollasch, Ute Grimm, Heiko Haupt, Susanne Homma, Anna bell Hormann, Andreas Hussner, Maike Isermann, Frank Klingenstein, Ingo Kowarik, Andreas Krüß , Daniel Lauterbach, Harald Martens, Stefan Nawrath, Stefan Nehring, Christelle Nowack, Wolfgang Rabitsch, Karsten Reise, Uwe Schippmann, Katrin Schneider, Eckhard Schröder, Birgit Seitz, Uwe Starfinger, Oliver Stöhr, Moritz von der Lippe, Christian Wiesner, Christian Wolter , Friederike Woog.



Rhea escaped from an enclosure (*Rhea americana*) have found themselves in the Wakenitztal angesiedelt (© S. Nehring).

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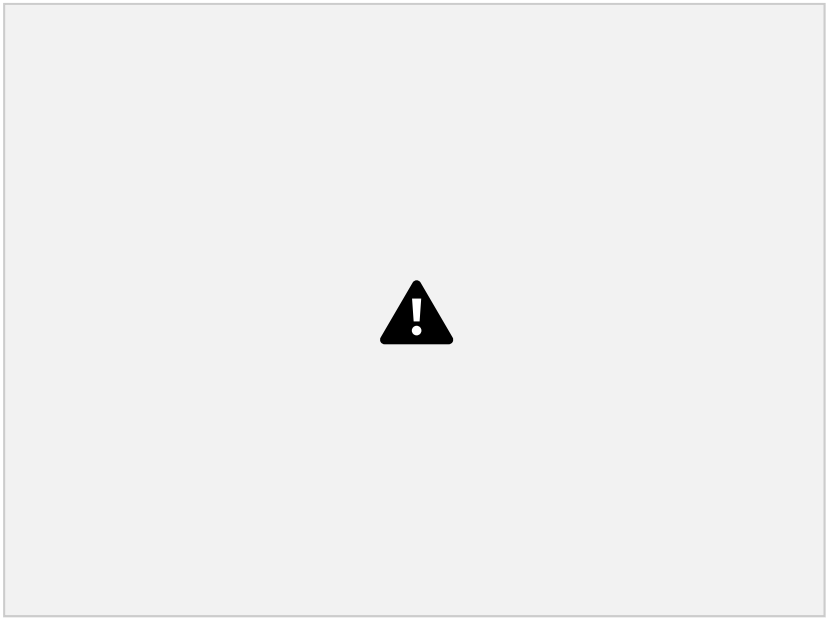

The Pacific rock oyster (*Crassostrea gigas*) spreads unhindered in the Wadden Sea (© S. Nehring).

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