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Rapid Assessment of Invasiveness (MERI) Method for Exotic Species in Mexico

A species is considered invasive exotic when it is not native, is found outside its natural distribution area, is capable of surviving, reproducing and establishing itself in natural habitats and ecosystems and threatens native biological diversity, the economy or public health (DOF, 2018).

The MERI is a pre-screening tool that can be used for all taxonomic groups to determine the invasion risk of an exotic species in Mexico. This methodology was developed through workshops and consultations with risk analysis experts (Barrios *et al.* 2014).

The scheme consists of 10 questions that are part of three main sections:
1) Status
2) Invasion process
3) Impacts

Each question is assigned a value ranging from zero to very high, with an associated numerical value. Each question is also assigned a degree of uncertainty depending on the reliability of the information supporting the answer. All information must be supported by verifiable references.
Depending on the reliability of the information sources used, uncertainty categories are classified from minimum to maximum.

The uncertainty values and the value of each question are combined using a multicriteria analysis to obtain the final invasiveness value for the species. Based on this value, the species will be classified according to its invasiveness risk as follows (Golubov *et al.* 2014):

Value	Risk level
0.0 to 0.125	Low
Greater than 0.125 and less than 0.250	Half
Greater than 0.250 and less than 0.500	High
Greater than 0.500	Very high

General considerations:

• It is necessary that the species evaluated is correctly identified with your valid name. If in doubt, this should be certified by a specialist.

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- The evidence used to answer the questions must be corroborable independently.

- Since it is impossible to assign a risk rating to species with incomplete assessments, no fields should be left blank; when there is no evidence to answer a question or the answer is unknown, the answer should be "unknown" and a maximum uncertainty level should be set.

- All responses must be documented and include full references that support each response. The assessment result and the reference documentation must be scientifically sound.

  be able to undergo peer review. When citing references, it is important to avoid inferring or interpreting the information.

- It should be noted that the identity of the taxon, the results of the evaluation, and the documentation used may be accessible to the general public.

- If it is a species that represents a potential risk for islands, endemism areas or Protected Natural Areas (PNA), it must be indicated so that specific prevention, control and management measures can be established.

- If a risk assessment (RA) for the species already exists for Mexico, it is not necessary to perform the Rapid Assessment Method for Invasiveness (RAM); the RA results will be used as the basis for decision-making regarding species management.

- If there is no AR for Mexico, it will be necessary to assess whether the species has established itself in areas with a climate compatibility with Mexico. If not, it will be considered that due to climatic restrictions, the species would not be able to establish itself in the country. In this case, the MERI is not required.

- The MERI consists of 10 questions, each with six possible response values (Very High, High, Medium, Low, No, and Unknown);
  The value is assigned according to guidelines that have been established to qualify each criterion.

Uncertainty

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Each response must include its respective uncertainty value (Table 1). This considers that knowledge about the factors contributing to risk is never absolute and takes into account the quality of the information used to make the assessment, as well as any missing or incomplete information. Five uncertainty categories were established: minimum, low, moderate, high, and maximum. Minimum uncertainty is assigned when there is solid information from several reliable sources. On the other hand, maximum uncertainty should be used in cases where no information exists or if the information comes from unreliable sources, for example, amateur websites. Ideally, each assessment should be reviewed by several people before being approved.

Uncertainty	Types of information sources
Minimum	Reliable sources of information such as: • Scientific or technical books or articles that have undergone peer review • Official publications (for example, SAGARPA, SEMARNAT, Ministry of Health, NAPPO, OIRSA, etc.) • Information from specialists
Low	• Specialized information databases (e.g., CABI-ISC, ISSG-IUCN, USGS-NAS, GIASIPartnership, FishBase, The PlantList, etc.) • Unpublished scientific or technical document
Average	• Technical scientific document without editorial approval • Specialist amateur publication • Non-peer-reviewed databases
High	• Contradictory information • Low-quality sources (e.g. blogs or forums) • Based on information from other species of the same gender
Maxima	• Lack of evidence • There is only one low-quality source

Table 1. Uncertainty values that should be assigned to each question depending on the associated information source.

Questions and criteria

The criteria for assigning values for each question are broken down below.

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1. Invasive report

Invasive alien species: A species or population that is not native, that is found outside its natural distribution area, that is capable of surviving, reproducing and establishing itself in natural habitats and ecosystems and that threatens native biological diversity, the economy or public health (DOF, 2018).

Very High: One or more risk analyses identify the species as a high-impact invasive species in any country or it is reported as an invasive pest in Mexico.

High: Report of invasion or documented impacts in several countries, or in a neighboring country or a country that trades with Mexico.

Medium: Report of invasion or documented impacts in several countries, other than neighboring countries or those with direct routes to Mexico. One or more ARs identify it as medium risk.

Low: Reports of barely perceptible or low-intensity impacts. One or more ARs identify it as low impact.

No: There is no evidence that the species is invasive although there is information on other aspects of the species.

Unknown: No verifiable information.

2. Relationship with nearby invasive taxa

Documented evidence of invasiveness of one or more species **with biology similar** to that of the species being assessed. Invasive species may possess undesirable characteristics that are not necessarily present in other taxonomically related species.

Very High: Evidence of kinship or lower taxonomic categories than species (variety, subspecies, race, etc.) or invasive hybrids.

High: Evidence that the species belongs to a genus in which invasive species exist or that equivalent species exist in other genera that are high-impact invasives.

Medium: Evidence that the species belongs to a family in which invasive species exist.

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Low: Evidence that the species belongs to the same family in which invasive species reported as having low impact exist.

No: There are no invasive taxa associated with the species, although there is information on other aspects of the species.

Unknown: No verifiable information.

3. Vector of other invasive species

The species has the potential to transport other invasive species (it is a vector) or pathogens and parasites of importance or impact on wildlife, humans or productive activities (for example, here it is marked if it is a vector of rabies, psittacosis, West Nile virus, cyanobacteria, etc.)

Very High: Evidence that the species may carry species harmful to one or more species in some risk category
(IUCN, NOM-059), or that the species comes from areas identified by the OIE, IPPC, NAPPO, CDC, SAGARPA, SS or
OIRSA as a source of dangerous pathogens and parasites. It is a vector of species that cause health problems such as
Zoonoses or phytosanitary epidemics, which can cause cascading damage to other species.

High: Evidence that the species can carry species harmful to several wild or economically important species.
Damage to populations of native species throughout their range.

Medium: Evidence that the species can carry pathogens that cause minor damage to some species, but that in the area where it is planned to be introduced, or has already been introduced, there are no native species that could be affected.

Low: Evidence that the species is a vector of species that cause minor impacts to a single species or population.

No: The species does not carry harmful species (the species may be susceptible to release from pathogens or other harmful species through treatment or quarantine).

Unknown: No verifiable information.

4. Risk of introduction

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Probability that the species has of reaching the country or of continuing to be introduced (in case it is already present or it is a translocation).

The importance of the pathway or number of pathways through which the species enters the national territory is highlighted. The number of individuals and the frequency of introduction also play a role.

Very High: Evidence that the species is in high demand, has a long-standing traditional use, or is essential for food security;
or has the ability to enter the country or enter new areas by one or more routes; the number of individuals is considerable and the frequency of introduction is high or is associated with activities
which encourage their dispersal or escape. There are no measures to control the introduction of the species into the country.

High: Evidence that the species is in high demand or has the potential to enter the country (or new areas) through one or more routes; the number of introduced individuals is considerable; there are few individuals with a high frequency of introduction, or the species is used for activities that encourage its dispersal or escape. Measures to prevent its entry are poorly understood or ineffective.

Medium: Evidence that the species is not in high demand or that there are few individuals with a high frequency of introduction. Measures are available to control its introduction and spread, but their effectiveness has not been proven under the conditions under which the species would be found in Mexico.

Low: Evidence that the species has limited demand or that the frequency and volume of introductions are low. Measures to control introductions are efficient and easy to implement.

No: The species is not in demand, and its introduction pathways are limited. Effective measures exist to control the introduction and spread of this species in Mexico.

Unknown: There is no verifiable information on routes, demand, volume and frequency of introduction.

5. Establishment risk

Probability that the species has of **reproducing and founding viable populations**
in a region outside their natural distribution range. This indicator takes into account the availability of measures to mitigate potential damage. In the case of established exotic species or translocated native species,

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assess the risk of establishment in new sites where they have not been previously reported.

Very High: Evidence that more than one population of the species has successfully established and is self-sustaining in at least one location outside its native range, and the number of individuals is increasing. Species with asexual reproduction, hermaphrodites, species that can store gametes for long periods, seeds, spores, or invertebrate cysts that remain dormant for several years. There are no mitigation measures.

High: Evidence that at least one population of the species has successfully established and is self-sustaining outside its known range. Species with any type of reproduction, species that exhibit parental care, species that exhibit an r strategy. Mitigation measures to prevent its establishment are poorly understood or ineffective.

Medium: Evidence that a population of the species has successfully established itself but has not thrived or is not reproducing. Species with any type of reproduction. Mitigation measures are available, but their effectiveness has not been proven under the conditions under which the species would be found in Mexico.

Low: Evidence that populations of the species have specific requirements to establish themselves independently outside their natural range (requires human assistance). Mitigation measures are efficient and easy to implement.

No: Populations of the species are not capable of establishing themselves self-sufficiently in regions outside their natural range.

Unknown: There is no information about the reproductive capacity and establishment success of the species outside its natural range.

6. Risk of dispersion

Probability of a species **expanding its geographic range** when it establishes in a region where it is not native. This indicator takes into account the availability of measures to mitigate potential damage.

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Very High: Evidence that the species is capable of establishing new, self-sustaining populations quickly and far from the original population, or is capable of spreading rapidly over large areas, allowing it to colonize new areas relatively quickly, through natural or artificial means. No mitigation measures are available.

High: Evidence that the species is capable of establishing new, viable populations far from the original population. Mitigation measures are poorly understood or ineffective.

Medium: Evidence that the species' geographic range is increasing. Mitigation measures are available, but their effectiveness has not been proven under the conditions in which the species would be found in Mexico.

Low: Evidence that the species requires assistance to disperse in the region or that mitigation measures are efficient and easy to implement.

No: The species cannot disperse.

Unknown: There is no information about the mechanisms or vectors of dispersal of the species in the region.

7. Health impacts*

Describe the impacts on human, animal, and/or plant health directly caused by the species. For example, indicate whether the species is poisonous, toxic, causes allergies, is a parasitoid, or is the causal factor of a disease (the species being evaluated is a virus, bacteria, etc.)*.

In the case of species that are carriers of pests and other species that cause diseases, the information should go in question 3.

Very High: There is evidence that the species itself causes, or may cause, effects on animal, human, and/or plant health.
It causes severe, large-scale damage and affects native species or those in some risk category (IUCN, NOM-059).

High: There is evidence that the species itself causes, or may cause, damage or impact on animal, human, and/or plant health in several wild or economically important species (throughout its range). It causes medium- to large-scale impacts.

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Medium: There is evidence that the species itself causes, or may cause, minor damage or impacts on animal, human, and/or plant health in a single species throughout its distribution area.

It causes minor, large-scale impacts. Or there are no native species in the area where it is planned to be introduced or has been introduced that could be affected.

Low: Minor impacts on animal, human, and/or plant health are reported only in a specific (targeted) population. Causes minor impacts on a small scale.

No: There is no information that the species causes health damage although there is information on other aspects.

Unknown: No information available.

*Grades:

- Consider the frequency of disease transmission

- Health impacts may include but are not limited to: Poisonous species, toxic (on contact), allergies, diseases, parasites, epidemics, parasitoids or fatal effects.

- The level of impact must be considered, for example, something that causes a treatable flu (human health) is less than one that causes crop loss.

8. Economic and social impacts

Describe the impacts on the economy and the social fabric. Consider the increased costs of productive activities, damage to infrastructure, economic losses due to damage or compensation for damage, loss of customs and traditions, social disintegration, etc.

Very High: There is evidence that the species causes, or may cause, irreversible impairment of productive capacity for a given economic activity in a region (unit, production area, or area of influence). There is no effective method for its containment or eradication.

High: There is evidence that the species causes or may cause considerable damage in some part of the production process; it can affect both the area and volume of production. The costs of control and containment measures are high.

Medium: There is evidence that the species causes or may cause moderate damage to productive capacity or a part of the production process. Mitigation measures are available to reduce the impact, but their effectiveness has not been proven under the conditions under which the species would be found in Mexico.

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Low: There is evidence that the species causes or may cause damage to productive capacity or a part of the production process, similar to that which a native species would cause. There are sufficient and accessible measures to reduce the impact.

No: There is no information that the species causes economic and social damage although there is information about other aspects of the species.

Unknown: No information available.

9. Impacts on the ecosystem

Describes the impacts on the environment; it refers to physical and chemical changes in water, soil, air, and light.

Very High: There is evidence that the species causes substantial, permanent and irreversible changes of great extent.

High: There is evidence that the species causes substantial temporary and reversible long-term changes (> 20 years) over large areas.

Medium: There is evidence that the species causes reversible changes in the medium and short term (5-20 years) in restricted areas.

Low: There is evidence that the species causes localized, perceptible changes without major effect on the environment or reversible in a period of less than 5 years.

No: There is no information that the species causes changes although there is information about other aspects of the species.

Unknown: No information available.

10. Impacts on biodiversity

Describe the impacts on communities and species, for example, through herbivory, competition, predation, and hybridization.

Very High: There is evidence that the species represents a risk of extinction for species in some risk category due to

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some biotic interaction (e.g. herbivory, frugivory, competition, predation, hybridization, parasitism, etc.) or there is a possibility that it will be introduced into sensitive ecosystems (islands, oases, etc.) or it will generate permanent changes in the community structure (alteration of food webs, changes in ecosystem structure, cascading damage and impact on key species).

High: There is evidence that the species has a high probability of produce fertile offspring by hybridization or cause long-term reversible changes (> 20 years) to the community (changes in food webs, competition for food and space, behavioral changes) or cause negative effects on the size of native populations.

Medium: There is evidence that the species has a low probability of producing fertile offspring by hybridization or causes reversible changes in the medium-short term (5-20 years) to the community (changes in food webs, competition for food and space, behavioral changes).

Low: There is evidence that hybridization has only occurred in captivity or evidence of little interaction (predation and competition) with native species. Damage comparable to that caused by native species.

No: There is no information that the species has impacts on biodiversity although there is information on other aspects of the species.

Unknown: No information available.

References

- Barrios,Y.,G.Born-Schmidt,AIGonzález,P.Koleff andR.Mendoza.2014. Advances in the development of criteria for defining and prioritizing invasive species, in R. Mendoza and P. Koleff (coord.), Invasive aquatic species in Mexico. National Commission for the Knowledge and Use of Biodiversity. pp. 113-121

- GolubovJ.,MCMandujano,S.Guerrero-Eloisa,R.Mendoza,P.Koleff,AI González, Y. Barrios and G. Born-Schmidt. 2014. Multicriteria analysis to assess the risk of invasive species, in R. Mendoza and P. Koleff (coords.). Invasive aquatic species in Mexico. National Commission for the Knowledge and Use of Biodiversity, Mexico, pp. 123-133.

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- DOF, 2018. General Wildlife Law. Decree amending various provisions of the Regulatory Law of Article 5.
  Constitutional Law regarding the exercise of professions in the Federal District, the Law of the National System of Statistical and Geographic Information, the General Law to Prevent and Punish Crimes Related to Kidnapping, Regulations of Section XXI of Article 73 of the Political Constitution of the United Mexican States, the General Law to Prevent, Punish and Eradicate Crimes Related to Human Trafficking

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