



A4.1a Ecosystem risk assessment framework

Project **INVALIS**

Protecting European Biodiversity from Invasive Alien Species



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Summary

ICETA designed an indicator framework for evaluating and monitoring the vulnerability status of natural ecosystems to invasive alien species (IAS). The framework is based on a number of environmental, socioeconomic and management indicators, all of which receive a quantified partial score according to their contribution to a) vulnerability to invasions and b) cost-effectiveness of actions preventing and/or controlling invasions. The purpose of this activity is to provide policy makers with an evidence based “tool” enabling them to prioritize actions and investments towards more vulnerable natural ecosystems. This deliverable thus corresponds to Task A4.1a Ecosystem risk assessment framework, led by ICETA (Portugal).

1. Introduction

Invasive Alien Species (IAS) are a major threat to biodiversity and natural ecosystems, representing the second biggest threat to biodiversity after habitat destruction. Their environmental impact can range from compromising single-species interactions and reducing native species fitness, to population declines or extinctions, changes in community composition and effects on ecosystem processes. Invasion also has severe economic and human health implications; evidence shows that IAS cause the loss of billions of euros to the EU economy every year. Unfortunately, there is an increasing trend in the establishment of exotic species in Europe's ecosystems, indicating that the problem is far from controlled. This is due to a) an increased international transport of foods and goods, including tourism; b) the intentional introduction of foreign species for economic reasons (e.g. aquaculture, farming); and c) an increasing vulnerability of ecosystems caused by anthropogenic degradation and climate change. As exotic species introduced through different pathways and vectors in natural ecosystems can easily move across the European territory, IAS management is unquestionably a transnational issue which must be dealt with in a concerted manner. Taking into account the different characteristics of INVALIS territories concerning the protection of natural ecosystems from IAS, interregional cooperation allows the exchange of experiences on determining efficient eradication/control methods, managing emerging conflicts of interests and engaging local communities in the

Territorial authorities play an essential role in shaping and implementing environmental policies to deal with IAS. They have direct responsibilities associated with managing and preventing biological invasions (following EU Regulation 1143/2014), such as maintaining surveillance systems for detecting, reporting and monitoring IAS presence/distribution, raising public awareness about the associated environmental and socioeconomic risks, implementing appropriate response actions, and taking measures to increase regional ecosystems' resilience. Public authorities are thus encouraged to adopt all necessary measures for managing and preventing new introductions of IAS.

Risk assessment frameworks can be especially useful for managing entities struggling to decide where to invest their finite budget whilst maximizing the probability of success. ICETA devised an indicator framework for evaluating and monitoring the vulnerability of

natural ecosystems to IAS, based on a number of easily quantifiable indicators focused on the environmental, socioeconomic and management characteristics of each ecosystem, in order to achieve a quantified score translating the ecosystem's vulnerability, but also the cost-effectiveness of acting on IAS. Given that this framework must be used by all INVALIS partners, ICETA ensured that it is:

- Clear
- Easy to apply
- Transferable, despite each partners' different realities and limitations

The aim of this activity is to provide policy makers with an evidence based tool that will enable them to prioritize actions and investments towards more vulnerable natural ecosystems. This activity is to be implemented through 3 sub-tasks, ensuring maximum framework applicability (Fig. 1).

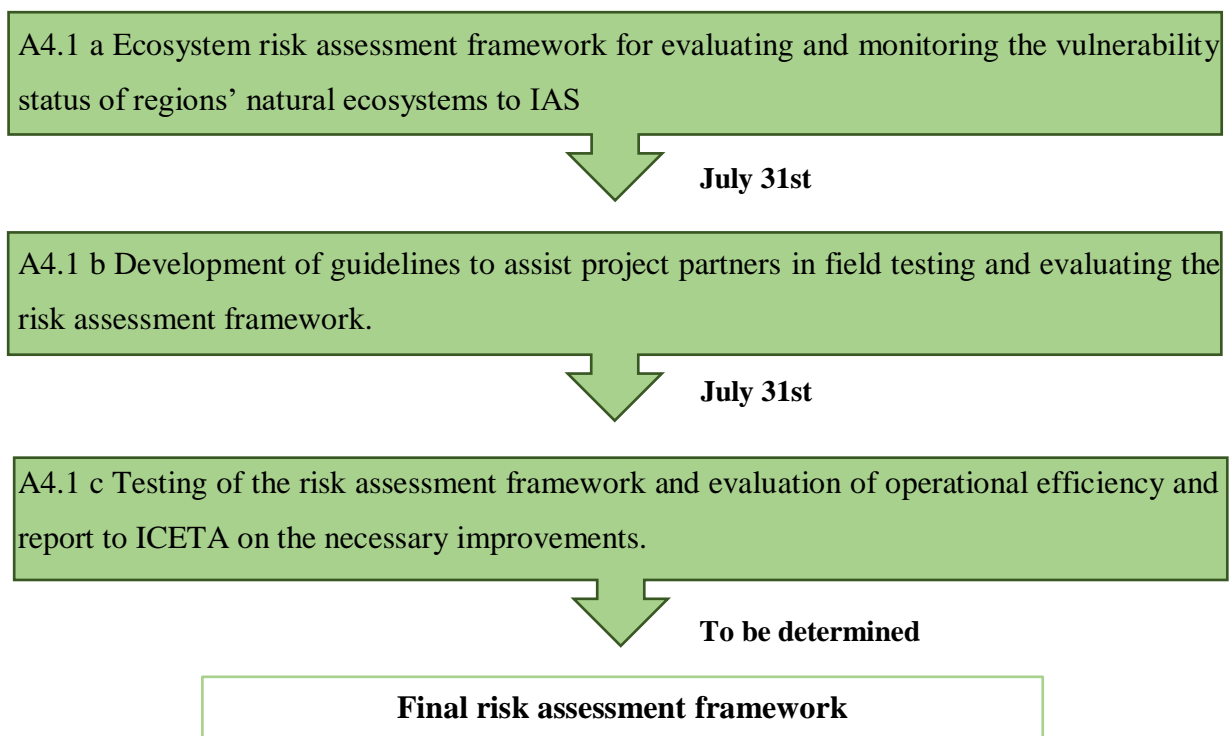


Fig. 1 Sub-tasks and timeline (aspects postponed and yet to be determined due to the coronavirus pandemic) of task A1.4.

2. Risk score components

Overall, an ecosystem's vulnerability to invasions depends on a number of intrinsic and external factors, such as the ecosystem's environmental characteristics, but also on management policies applied.

An ecosystem is often considered “invader friendly” when it displays certain characteristics that make it more prone to biological invasions, such as closeness to inhabited centers and ease of access from surrounding rural or urban areas (Zaiko et al. 2007). Environmental characteristics may favour an ecosystem's vulnerability to IAS, such as a high/intermediate level of biodiversity, low current presence of IAS, and proximity to pristine areas (Albertson and Elton 1960). Although a simple general theory of the relationship between diversity and invasibility is probably unrealistic (Fridley et al. 2007), these characteristics are generally assumed to protect ecosystems from the entrance of new species (Levine et al. 2004).

Policy options (from awareness raising to habitat restoration) may also influence the invasibility of ecosystems, and conflicts of interest (e.g., economic, cultural or social) may compromise mitigation projects and the implementation of actions against IAS (Keller et al. 2011). Ecosystem vulnerability might increase if specific legislation against IAS is lacking or poorly enforced, and if the managing authority has low economic resources and/or lack of specialized staff to implement actions targeting biological invasions (Norwegian Ministry of the Environment 2007).

Hence, in order to create a thorough indicator framework for evaluating and monitoring the vulnerability status of regions' natural ecosystems to IAS, both environmental, socioeconomic and management factors must be acknowledged. The following sections explain each component of the proposed risk score, risk assessment framework to be presented to each partner, and score calculation.

2.1. Environmental characteristics

First, the risk score here proposed evaluates the environmental characteristics of the ecosystem, using standardized and easily quantifiable metrics of protected habitats, species and bird species. Hence, the user is presented with the following questions:

- 1. How many protected habitats (Habitats Directive, Annex I) are present in your area?*
- 2. How many protected species (Habitats Directive, Anexo II) does your area host?*
- 3. How many protected bird species (Birds Directive) does your area host?*

Afterwards, and because the amount of IAS present in an ecosystem can heavily increase its vulnerability to future invasions, the risk score framework asks the user to provide an estimation for the number IAS already established in the assessed ecosystem.

- 4. How many invasive alien species of union concern does your area host?*

Most INVALIS ecosystems previously assessed share characteristics that favour the process of invasion, namely:

- intermediate level of habitat degradation and anthropogenic disturbance;
- landscape mainly composed of rural or urban areas with intense agriculture or livestock activities.
- Ease of access and closeness to inhabited centres;
- Tourism is a relevant activity, as well as other recreational activities, recognised as common sources of IAS introduction.

On the other hand, the ecosystems within INVALIS partners have other characteristics that decrease their vulnerability:

- Intermediate/high level of biodiversity;
- Existence of projects or management actions against IAS that do not cause a high level of conflicts of interest.

Overall, regarding risk score quantification, more protected habitats and species correspond to higher scores, and thus increased risk (higher value for action prioritization), whereas more invasive species established lower the score, as heavily invaded habitats should not be prioritized, independently of the original environmental value provided by protected habitats and species.

However, this is a composite risk score, as an ecosystems' vulnerability to invasions is a multifaced aspect dependent on environmental factors intrinsic to each ecosystem, but it is also highly driven by socioeconomic activities and managing policies.

2.2. Socioeconomic characteristics

Anthropogenic socioeconomic activities are known to promote the entrance and establishment of IAS in natural ecosystems. Hence, to account for the existence of such activities in the assessed ecosystems, the risk score framework asks the user to indicate how many of the main socioeconomic activities are present in the assessed area.

5. Please state how many of the following activities occur in your assessment area:

Tourism

Agriculture

Fishing

Hunting

Urban development

This is an additive variable; if all are present, risk of IAS presence is higher, thus lowering the score, as heavily anthropized ecosystems should not be prioritized for action, given that probability of success is low.

2.3. Management characteristics

The management of IAS is not easy to address, but may determine an ecosystem's proneness to invasions. To quantify management aspects in the risk score, we used the indicators provided in task *A1.3 Capacities and management needs of territorial authorities related to the design and implementation of measures in IAS policies*.

Thus, the framework starts by presenting the user with the following:

6. The design and implementation of IAS-related measures is a high priority for your organization.

This indicator will be provided with a Likert scale, in which the user can state if he/she disagrees completely, somewhat disagrees, neutral, somewhat agrees or agrees completely (1-5). In this case, higher scores will contribute to lower risks, as ecosystems proactively managed will not be at highest risks for biological invasions, and thus do not need to be prioritized for action.

Afterwards, users will be asked to quantify how many IAS policies are implemented by the authority managing the ecosystem under assessment.

7. Please state in how many of the following areas of IAS management is your organisation active.

Early detection

Eradication

Population control

Containment

Restoration of damaged ecosystems

Risk assessment

Authorising/regulators for permits & authorisations

Data collection for national/regional surveillance system

Communication campaigns/raising awareness

This indicator is additive, so that if all policies are implemented, risk is lower.

Users are then asked to provide information on additional managing aspects, namely:

8. Managing organization is involved in policy-making of IAS management in EU, national, regional as well as local level.

9. Managing organization has strong leadership providing goals and priorities to the staff regarding IAS management.

10. Managing organization has the ability to develop and refine a strategic plan towards IAS.

11. Managing organization has sustainability plans for IAS projects & programmes.

12. Managing organization has the ability to assign specific roles to different persons and departments, according to their educational background and field of expertise.

All of these indicators follow a Likert scale, in which the user can state if he/she disagrees completely, somewhat disagrees, neutral, somewhat agrees or agrees completely (1-5). Higher scores will contribute to lower risks, as ecosystems proactively managed will not be at highest risks for biological invasions, and thus do not need to be prioritized for action.

Next, the user is asked to provide information regarding how the managing authority uses previous actions to inform and improve future actions:

13. Does your organization evaluate ongoing and previous IAS activities to (please state how many are applicable):

To improve current program activities

To highlight successful practices

To fulfil current funding requirements

To obtain new grants or contracts

To inform decision-makers outside of the organisation

To advocate for policy change

To monitor program progress

Have not used the data yet

My organization does not evaluate previous IAS activities

This indicator is also additive, so if many policies are implemented, risk is lower.

Finally, the user is asked to provide information on various aspects related to the authority managing the ecosystem's internal policies regarding IAS actions.

- 14. Managing organisation employs staff who know how to develop data collection tools and collect data.*
- 15. Managing organisation employs staff who knows how to analyse interpret evaluation findings.*
- 16. Managing organisation has adequate electronic database and management reporting systems.*
- 17. Managing organisation identified internal and external indicators to measure the impact of the organization's work.*
- 18. Managing organisation has adequate personnel to carry out its designated mission.*
- 19. Managing organisation regularly analyses HR skill needs to support the implementation of IAS measures.*
- 20. Managing organisation has a communication plan/guidelines in place, to define the overall communication strategy.*
- 21. Managing organisation implements awareness-raising campaigns on IAS related issues.*
- 22. Managing organisation effectively communicates with potential funders.*
- 23. Managing organisation uses various communication channels, including digital and print media.*
- 24. Managing organisation applies regularly for IAS funding (private/non-governmental/governmental/EU).*

All of these indicators follow a Likert scale, in which the user can state if he/she disagrees completely, somewhat disagrees, neutral, somewhat agrees or agrees completely (1-5). Higher scores will contribute to lower risks, and thus decrease prioritization for action.

2.4 Risk score framework

Component	Question	Type	Rationale	Support material
Regarding the assessed area, please state:				
Environmental	1. How many protected habitats (Habitats Directive, Annex I) are present in your area?	Numeric	More protected habitats correspond to higher scores (increased risk)	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:01992L0043-20130701
	2. How many protected species (Habitats Directive, Anexo II) does your area host?	Numeric	More protected species correspond to higher scores	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:01992L0043-20130701
	3. How many protected bird species (Birds Directive) does your area host?	Numeric	More protected species correspond to higher scores	https://ec.europa.eu/environment/nature/conservation/wildbirds/threatened/index_en.htm

	4. How many invasive alien species of union concern does your area host?	Numeric	More invasive species present correspond to lower scores (more invaded habitats should not be prioritized)	https://ec.europa.eu/environment/nature/invasivealien/docs/R2016_1141_Union-list-2019-consolidation.pdf
Socioeconomic	5. Please state how many of the following activities occur in your assessment area:	Additive	If all are present, risk is higher, score is lower	
	Tourism			
	Agriculture			
	Fishing			
	Hunting			
	Urban development			

Regarding the organization managing the assessed area, please state:				
IAS Management	6. The design and implementation of IAS-related measures is a high priority for the organization.	Likert scale disagrees completely, somewhat disagrees, neutral, somewhat agrees or agrees completely (1-5)	Higher scores, lower risk	
	7. Please state in how many of the following areas of IAS management is your organization active.	Additive	If all are present, risk is lower	
	Early detection			
	Eradication			
	Population control			
	Containment			
	Restoration of damaged ecosystems			
	Risk assessment			
	Authorizing/regulators for permits & authorizations			
Data collection for national/regional surveillance system				

	Communication campaigns/raising awareness			
8. Managing organization is involved in policy-making of IAS management in EU, national, regional as well as local level.	Likert scale	1-5; Higher score, lower risk		
9. Managing organization has strong leadership providing goals and priorities to the staff regarding IAS management.				
10. Managing organization has the ability to develop and refine a strategic plan towards IAS.				
11. Managing organization has sustainability plans for IAS projects & programs.				
12. Managing organization has the ability to assign specific roles to different persons and departments, according to their educational background and field of expertise.				

13. Does your organization evaluate ongoing and previous IAS activities to (state how many are applicable):	Additive	If many are present, risk is lower	
To improve current program activities			
To highlight successful practices			
To fulfil current funding requirements			
To obtain new grants or contracts			
To inform decision-makers outside of the organization			
To advocate for policy change			
To monitor program progress			
Have not used the data yet			
My organization does not evaluate previous IAS activities			
14. Managing organization employs staff who know how to develop data collection tools and collect data.	Likert scale	1-5; Higher score, lower risk, lower risk score	

	15. Managing organization employs staff who knows how to analyze and interpret evaluation findings.			
	16. Managing organization has adequate electronic database and management reporting systems.			
	17. Managing organization identified internal and external indicators to measure the impact of the organization's work.			
	18. Managing organization has adequate personnel to carry out its designated mission.			
	19. Managing organization regularly analyses HR skill needs to support the implementation of IAS measures.			
	20. Managing organization has a communication plan/guidelines in place, to define the overall communication strategy.			
	21. Managing organization implements awareness-raising campaigns on IAS related issues.			

	22. Managing organization effectively communicates with potential funders.			
	23. Managing organization uses various communication channels, including digital and print media.			
	24. Managing organization applies regularly for IAS funding (private/non-governmental/governmental/EU).			

2.5 Risk score calculation

First, the environmental characteristics of the ecosystems are heavily weighted in the risk score calculation, given its intrinsic character. The amount of IAS and socioeconomic activities present in the assessed ecosystems is then subtracted to the amount of protected habitats, species and birds, because the presence of IAS decreases ecosystem priority for action, thus resulting in lower scores.

$$RS_1 = 0.7 * (\textit{Protected habitats} + \textit{Protected species} + \textit{Protected bird species} - \textit{Number of IAS} - \textit{Socioeconomic activities})$$

RS_1 = Risk score environmental component

The second component of the risk score describes the IAS management quality implemented in the ecosystem being assessed. As these are evaluated following both Likert scale and additive indicators, this component has two partial scores: one for the Likert scale indicators (RS_2 , evaluated using the correct central tendency measure, the median), and another for the additive indicators (RS_3 , evaluated using the mean).

$$RS_2 = 0.15 * \textit{Median(Management likert scale indicators)}$$

RS_2 = Risk score management component (partial)

$$RS_3 = 0.15 * \textit{Average(Management additive indicators)}$$

RS_3 = Risk score management component (partial)

Overall, the total risk score is calculated as follows:

$$RS = RS_1 - RS_2 - RS_3$$

The risk score is open scaled, as it depends on the initial numbers provided for protected habitats and species. Overall, lower scores correspond to ecosystems with relevant protected habitats and species, but low number of IAS and/or anthropogenic activities, with managing authorities involved in IAS prevention and/or control. These ecosystems with lower scores will not be prioritized for action, even when harbouring very important natural assets. On the other hand, ecosystems with higher scores will have relevant natural assets, not many IAS and anthropogenic activities established, but incipient management policies directed towards IAS preventions and/or control; these ecosystems will thus be prioritized by the risk score.

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