Flanders
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Prioritising invasive alien species for monitoring in Flanders

Results of an expert survey

Janne Adolf, Diederik Strubbe, Tim Adriaens, Thierry Onkelinx

INBO.be

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PRIORITISING INVASIVE ALIEN SPECIES FOR MONITORING IN FLANDERS

Results of an expert survey

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Summary

This report presents a survey-based framework to prepare the development of structured, policy-relevant monitoring schemes for invasive alien species in Flanders. Under the EU Invasive Alien Species Regulation ('Regulation (EU) no 1143/2014', 2014), member states are required to set up surveillance systems for species of Union Concern, including the establishment of systems for early detection and for monitoring species' distributions and management outcomes. In the Flemish region, the Research Institute for Nature and Forest (INBO) is legally tasked with designing and coordinating monitoring efforts for (potentially) invasive alien species. However, Flanders currently lacks a coherent monitoring programme that systematically addresses all species on the Union List.

Existing efforts consist of a fragmented landscape of initiatives, often project-based and time-limited, with varying geographic and taxonomic coverage. These include professional and citizen science-based projects dedicated to specific species groups, professional monitoring schemes with broader ecological aims, and opportunistic observations collected through public biodiversity reporting portals such as waarnemingen.be ('Waarnemingen.be', s.d.). Despite their contributions, these initiatives are not methodologically aligned and do not collectively meet the requirements of the EU Invasive Alien Species Regulation.

To support the design of future invasive alien species monitoring schemes, an expert survey was conducted covering all 114 species on the current Union List ('Commission implementing regulation (EU) 2025/1422', 2025), as well as 8 candidate species that were considered for inclusion in 2025, but were ultimately discarded. The survey gathered species-specific information and expert judgements on the introduction, distribution, abundance, impacts, management and monitoring status in Flanders. The collected responses were condensed into overall ratings of the **feasibility** and **urgency** of **structured monitoring schemes** for the species under consideration.

These survey results then informed a two-stage prioritisation process. Distinguishing the monitoring scopes of detection, inventory, distribution, abundance, and distribution or abundance under management, we aimed to identify a limited number of species-scope combinations with high relevance and priority. In a first stage, the relevance of the different monitoring scopes was assessed per species using criteria such as invasion stage, management status, and method availability. Irrelevant species-scope combinations were excluded. In a second stage, the priority of remaining combinations was assessed based on the overall feasibility and urgency ratings, as well as on experts' responses to selected critical survey questions. The outcome of the prioritisation process was a selection of relevant high-priority species–scope combinations for monitoring scheme development.

To further structure the prioritisation results, three strategic focus scenarios were developed, each concerning a subset of the prioritised species and monitoring scopes: (1) species previously prioritised for management; (2) species requiring mainly early detection; and (3) species for which primarily distribution monitoring is relevant. For each scenario, commonalities in monitoring methods between species were explored to identify potential method-based synergies relevant for cost-efficient coordination and/or implementation.

A steering committee involving representatives from INBO, the Agency for Nature and Forests (ANB) and the Flanders Environment Agency (VMM) reviewed the survey and prioritisation outcomes and agreed on a final short-list of four species(groups) as a proof of concept for monitoring scheme development. These include *Muntiacus reevesi (Ogilby, 1839)* [EN: Chinese muntjac, NL: Chinese muntjak], *Trachemys scripta (Thunberg In Schoepff, 1792)* [EN: common slider, NL: lettersierschildpad], *Lithobates catesbeianus (Shaw, 1802)* [EN: American bull frog, NL: Amerikaanse stierkikker], and, subsumed as a group, *Ludwigia grandiflora (Michx.) Greuter & Burdet* [EN: large-flower primrose-willow, NL: waterteunisbloem] and *Ludwigia peploides (Kunth) P.H.Raven* [EN: floating primrose-willow, NL: kleine waterteunisbloem]. For each, one or more main monitoring scopes were identified, often linked to evaluating ongoing or future management actions.

The development of monitoring schemes for these species should proceed based on the methodological guidelines developed by INBO (Wouters *et al.*, 2008) to ensure reliable and policy-aligned monitoring results.

Dutch executive summary

De volgende beleidssamenvatting in het Nederlands is een uitgebreide versie van de voorafgaande kortere Engelse samenvatting. Het rapport zelf is in het Engels geschreven om het voor een breder publiek toegankelijk te maken.

Dit rapport presenteert een op een expert survey gebaseerd kader ter voorbereiding van het ontwerp van gestructureerde, beleidsrelevante meetnetten voor invasieve uitheemse soorten in Vlaanderen. Onder de EU Verordening betreffende invasieve uitheemse soorten ('Regulation (EU) no 1143/2014', 2014, Artikel 14) zijn lidstaten verplicht om toezicht te houden op een lijst van voor de Unie zorgwekkende invasieve uitheemse soorten (de Unielijst). Dit omvat het opzetten van systemen voor vroegtijdige detectie, het monitoren van de verspreiding van soorten en het opvolgen van beheer. De Verordening vermeldt dat deze systemen best complementair zijn aan de monitoringssystemen van de Habitatrichtlijn, de Kaderrichtlijn Water, en de Kaderrichtlijn Mariene Strategie. In Vlaanderen is het Instituut voor Natuur- en Bosonderzoek (INBO) formeel belast met het opvolgen van de toestand van (potentieel) invasieve soorten ('Decree of the flemish government of 15 may 2009', 2009). Het INBO is derhalve bevoegd voor de uitwerking van monitoringssystemen en de coördinatie van de uitvoering ervan. Vlaanderen heeft momenteel echter geen coherent monitoringsprogramma dat systematisch alle soorten van de Unielijst en andere (potentieel) invasieve soorten opvolgt.

De bestaande inspanningen vormen een versnipperd landschap van initiatieven, vaak projectmatig en in de tijd beperkt, met een variërende geografische en taxonomische dekking. Deze omvatten professionele en op burgerwetenschap gebaseerde programma's die zich richten op specifieke soortengroepen, professionele meetnetten met bredere ecologische doelstellingen en opportunistische waarnemingen die verzameld worden via openbare biodiversiteitsportalen zoals waarnemingen.be ('Waarnemingen.be', s.d.). Ondanks hun bijdragen zijn deze initiatieven methodologisch niet op elkaar afgestemd en voldoen ze collectief niet aan de vereisten van de EU Verordening rond monitoring van invasieve uitheemse soorten.

Om het ontwerp van toekomstige, coherente meetnetten voor invasieve uitheemse soorten te ondersteunen, werd een survey onder soortenexperts uitgevoerd die alle 114 soorten van de huidige Unielijst ('Commission implementing regulation (EU) 2025/1422', 2025) omvatte, evenals 8 kandidaatsoorten die werden beschouwd voor opname in de Unielijst in 2025, maar die uiteindelijk niet geselecteerd werden door de Europese Commissie. De survey verzamelde soortspecifieke informatie en expertkennis over de introductie, verspreiding, abundantie, impact, het beheer en de monitoring in Vlaanderen. De antwoorden werden samengevat tot algemene scores rond de **haalbaarheid** en de **urgentie** van **gestructureerde meetnetten** voor de soorten in kwestie.

Met deze survey wilden we de relevantie en prioriteit bepalen van verschillende monitoringsscopes voor de beoordeelde soorten en een beperkt aantal soort-scope combinaties met hoge relevantie en prioriteit identificeren. We maken onderscheid tussen zes mogelijke monitoringsscopes: *detectie* (om de aanwezigheid vast te stellen in gebieden waar de soort afwezig is), *inventarisatie* (om de verspreiding van een soort initieel in kaart te brengen), *verspreiding* (om de status en trend van de verspreiding van een soort te meten), *abundantie* (om de status en trend van de populatiegrootte van een soort te meten), *verspreiding onder beheer* en *abundantie onder beheer* (beide om de status en trend van de verspreiding of populatiegrootte van een soort te meten in gebieden waar beheer plaatsvindt).

In een eerste fase van een tweefasig prioriteringsproces werd de relevantie van de verschillende monitoringsscopes per soort bepaald aan de hand van criteria gebaseerd op het huidige invasiestadium van de soort, of de soort beheerd wordt, of de gebieden voor monitoring bekend zijn en of er geschikte monitoringstechnieken beschikbaar zijn. Soort-scope combinaties die op basis van deze criteria als irrelevant werden beschouwd, werden uitgesloten van verdere overweging.

In een tweede fase werd de prioriteit van de overblijvende soort-scope combinaties beoordeeld. De prioriteit werd bepaald op basis van de algemene haalbaarheids- en urgentiescores die uit de survey naar voren kwamen. Daarnaast werden de antwoorden op bepaalde kritische surveyvragen gebruikt om beslissingen over uitsluiting te onderbouwen, bijvoorbeeld wanneer experts meldden dat opportunistische gegevensverzameling al voldoende dekking bood voor een soort. De toepassing van deze filters leverde een selectie van soort-scope combinaties die als zeer relevant en prioritair werden beschouwd voor de ontwikkeling van toekomstige meetnetten. Hoewel er geen volledige aanbodzijdeanalyse is uitgevoerd, wordt bij deze prioritering dus al in zekere mate rekening gehouden met de noodzaak om nieuwe meetnetten te ontwikkelen.

Om de resultaten van de prioritering verder te structureren, werden drie strategische scenario's ontwikkeld, elk met betrekking tot een subset van de geprioriteerde soorten en monitoringsscopes.

Scenario 1 (monitoring voor beheer) richt zich op soorten die reeds als beheersprioriteit zijn aangeduid. Voor deze soorten is vooral monitoring nodig om maatregelen voor uitroeiing, indamming en populatiebeheer te begeleiden. Relevante monitoringsscopes in dit scenario zijn *verspreiding en abundantie onder beheer*.

Scenario 2 (monitoring voor detectie) omvat soorten waarvoor vroegtijdige opsporing de voornaamste zorg is. Dit zijn soorten met een zware ecologische impact die ofwel afwezig zijn ofwel slechts sporadisch voorkomen in Vlaanderen, of die afwezig zijn in belangrijke natuurgebieden waar impact zich kan manifesteren. *Monitoring voor detectie* kan snelle interventies ondersteunen en de kans op een succesvolle preventie of vroegtijdige uitroeiing vergroten.

Scenario 3 (monitoring voor verspreiding) omvat soorten waarvoor *monitoring van de verspreiding* het meest relevant is en sluit aan bij de meest expliciet gedefinieerde zesjaarlijkse rapportageverplichtingen onder de EU Verordening betreffende invasieve uitheemse soorten.

Om de monitoring kostenefficiënt te kunnen uitvoeren, werden voor elk scenario de door de experten gerapporteerde monitoringstechnieken geanalyseerd om overeenkomsten en dus potentiële synergieën op basis van methoden tussen meerdere soorten te identificeren. In verschillende gevallen werden overeenkomsten gevonden, bijvoorbeeld met betrekking tot het gebruik van omgevings-DNA voor aquatische soorten (bv. rivierkreeften, vissen), visuele surveys voor terrestrische planten of cameravallen voor terrestrische zoogdieren (bv. Chinese muntjak, wasbeer). Dit biedt mogelijkheden voor gecoördineerde planning en gecoördineerde implementatie van meetnetten voor meerdere soorten tegelijk. Er is echter verder onderzoek nodig om te bepalen in welke mate deze potentiële synergieën kunnen worden gerealiseerd.

De resultaten van de survey en het prioriteringsproces werden geëvalueerd door een stuurgroep met onderzoekers van het INBO en vertegenwoordigers van het Agentschap voor Natuur en Bos (ANB) en de Vlaamse Milieumaatschappij (VMM). Op basis van deze evaluatie kwam de stuurgroep tot een shortlist van vier soorten(groepen) voor het prioritair ontwerpen van een meetnet. Deze selecties weerspiegelen een evenwicht tussen ecologische relevantie, huidige beheersbehoeften, haalbaarheid van monitoring en beleidsprioriteiten. De geselecteerde soorten en bijbehorende monitoringsscopes zijn als volgt.

Muntiacus reevesi (Ogilby, 1839) [EN: Chinese muntjac, NL: Chinese muntjak], een kleine hertensoort met een momenteel beperkte maar mogelijk uitbreidende verspreiding in Vlaanderen. De soort is het voorwerp van voortdurende uitroeiingsinspanningen. De meest relevante monitoringsscope betreft *abundantie onder beheer*, om populatieafnames op te volgen en het succes van lokale uitroeiing te bevestigen.

Trachemys scripta (Thunberg In Schoepff, 1792) [EN: common slider, NL: lettersierschildpad], een via de dierenhandel verspreide waterschildpad die vaak in de natuur wordt gedumpt. Hoewel momenteel niet bevestigd is dat de soort zich voortplant in Vlaanderen, is ze wijdverspreid. De meest relevante monitoringsscopes zijn *inventarisatie* (om het huidige verspreidingsgebied in kaart te brengen) en *abundantie onder beheer* (voor sites waar afvangst plaatsvindt).

Lithobates catesbeianus (Shaw, 1802) [EN: American bull frog, NL: Amerikaanse stierkikker], een amfibie-ënsoort met een ruime maar geconcentreerde verspreiding in Vlaanderen, die onderhevig is aan populatiebeheer. De meest relevante monitoringsscopes zijn *abundantie onder beheer* en *verspreiding*, vooral aan de randen van het huidige verspreidingsgebied aangezien het stoppen van verdere uitbreiding een expliciete doelstelling is van het gevoerde beheer.

Ludwigia grandiflora (Michx.) Greuter & Burdet [EN: large-flower primrose-willow, NL: waterteunisbloem] en *Ludwigia peploides (Kunth) P.H.Raven* [EN: floating primrose-willow, NL: kleine waterteunisbloem], twee soorten waterplanten die respectievelijk wijd en beperkt verspreid zijn. Beide soorten worden op verschillende locaties beheerd. De meest relevante monitoringsscope is *abundantie onder beheer*, om populatie-afnames op te volgen en lokale uitroeiing te bevestigen.

Deze soorten werden door de stuurgroep geduid als belangrijke soorten voor een proof of concept voor de ontwikkeling van gestructureerde meetnetten. Deze meetnetten moeten ontwikkeld worden in overeenstemming met de methodologische richtlijnen van het INBO (Wouters *et al.*, 2008). Deze richtlijnen bieden een principieel kader voor het afstemmen van monitoringsdoelen, gegevensverzameling, gegevensanalyse en rapportage op de ware informatiebehoeften, wat betrouwbare, robuuste en beleidsrelevante inzichten oplevert. Dit rapport biedt een belangrijke basis voor deze volgende fase. Naast een prioritering van soorten en monitoringsscopes, en een geconsolideerde shortlist, biedt het een methodologie voor beslissingsondersteuning, een voorstel voor het vormen van soortgroepen voor monitoring, en een empirisch overzicht van expertinzichten in de huidige status van invasieve uitheemse Unielijst soorten in Vlaanderen.

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1 INTRODUCTION

Belgium is legally obligated to monitor invasive alien species (IAS) on the List of Invasive Alien Species of Union Concern (Union List in short) under the EU Invasive Alien Species Regulation ('Regulation (EU) no 1143/2014', 2014). For the Flemish region, the coordination of such monitoring is a statutory task of the Research Institute for Nature and Forest (Instituut voor Natuur- en Bosonderzoek; INBO). However, despite this obligation, Flanders currently still lacks a dedicated and coherent monitoring programme that systematically covers all Union List species (Maes *et al.*, 2023).

Instead, a considerable number of independent monitoring and early alert initiatives exist, forming a rather heterogeneous mix. Some initiatives are species- or taxon-focused and operate across the entire Flemish region, such as Vespawatch (INBO, s.d.a), Flatwormwatch (INBO, s.d.b) and Craywatch (INBO & ANB, s.d.), which are also largely citizen science-based. Others, such as LIFE 3n-Bullfrog (ANB, s.d.a), LIFE DUNIAS (ANB, s.d.b), LIFE RIPARIAS ('LIFE RIPARIAS early alert', s.d.), and LIFE MICA ('LifeMica', s.d.), also focus on particular taxa but are geographically restricted to specific regions or ecosystems and often involve a mix of professional and citizen-based monitoring. These initiatives are typically project-based, not structurally funded, and therefore time-limited unless explicitly extended. In addition, a large amount of IAS data is collected opportunistically through biodiversity reporting platforms like waarnemingen.be ('Waarnemingen.be', s.d.), which - although not designed for IAS specifically - capture many relevant records thanks to their widespread use. Lastly, some IAS are recorded incidentally in professional monitoring schemes targeting native species (Maes *et al.*, 2023).

This fragmented and largely uncoordinated situation highlights the need for a more structured and strategic approach to IAS monitoring in Flanders. A future IAS monitoring programme should aim to better integrate these existing efforts — both citizen science and professional monitoring — while filling gaps through the development of new, targeted monitoring schemes. Ideally, such a programme would draw on a methodological framework to closely align monitoring targets, data collection, data analysis and reporting with policy needs, ensuring reliable, robust, and policy-relevant insights. Promoting such a framework, INBO has developed extensive guidelines for designing policy-oriented monitoring schemes (Wouters *et al.*, 2008). The guidelines have successfully been applied, for instance in response to the EU Habitat Directive ('Council directive 92/43/EEC', 1992) where they underlie the corresponding species monitoring schemes (De Knijf *et al.*, 2014).

The endeavour documented in the current report aims to lay the groundwork for future applications of the INBO monitoring guidelines to plan structured monitoring schemes for IAS in Flanders. As a first step, we designed and conducted an expert survey to collect targeted information on IAS in the Flemish region. This concerns the species' invasion stage - including their present and expected introduction, distribution, abundance, and impacts; their assessment via existing monitoring schemes and opportunistic data; the quality, costs, and feasibility of available monitoring techniques; and whether the species are currently subject to management actions. The survey results were then used in a prioritisation process to identify a limited number of species for which monitoring schemes should be developed with priority. The survey project was concluded with a meeting of a steering committee involving external stakeholders from the Agency for Nature and Forests (Agentschap voor Natuur en Bos; ANB) and the Flanders Environment Agency (Vlaamse Milieumaatschappij; VMM) who evaluated the project's results and took the final decision on which species or species groups should be prioritised for the future development of proof of concept monitoring schemes.

The remainder of this report is structured as follows: the design of the expert survey and the employed prioritisation methodology are described in detail in Chapter 3. The survey results are presented in Chapter 4 including selected descriptive results and the results of the prioritisation process. A summary of the steering committee meeting and decision is provided in Chapter 5. Before proceeding however, we first provide some relevant background information. In Chapter 2, we first briefly summarize the relevant legislation on IAS monitoring in Flanders, including provisions at both the EU and Flemish levels. This is followed by a note on terminology, clarifying differences between how terms are used in legislative texts and how they are applied in this report. We then introduce a distinction between different types of monitoring scopes - referring to specific objectives and designs of monitoring schemes depending on the species' invasion stage and management context. For example, some scopes aim at early detection of species not yet present in Flanders, while others focus on assessing trends in abundance or evaluating control measures for already widespread species. This distinction of different monitoring scopes will be used throughout the report to help structure and interpret the survey results.

2 MONITORING SCHEMES FOR INVASIVE ALIEN SPECIES IN FLANDERS: SOME BACKGROUND

2.1 THE LEGAL CONTEXT

2.1.1 The EU Invasive Alien Species Regulation

At the level of the EU, legislation on IAS is bundled in the Invasive Alien Species Regulation ('Regulation (EU) no 1143/2014', 2014). The regulation applies to a list of 114 IAS of Union concern, which is subject to regular updates and extensions ('Commission implementing regulation (EU) 2016/1141', 2016; 'Commission implementing regulation (EU) 2017/1263', 2017; 'Commission implementing regulation (EU) 2019/1262', 2019; 'Commission implementing regulation (EU) 2022/1203', 2022; 'Commission implementing regulation (EU) 2025/1422', 2025). For species on the Union List EU member states are, among other things, required to set-up a "surveillance system" that allows "for early detection of new invasive alien species and for the determination of the distribution of already established species" ('Regulation (EU) no 1143/2014', 2014, p. 4), as well as for monitoring the effectiveness of measures of (early) eradication, population control or containment ('Regulation (EU) no 1143/2014', 2014, pp. 16–17).

The Invasive Alien Species Regulation and The Commission Implementing Regulation on the formats for reporting under the Invasive Alien Species Regulation ('Commission implementing regulation (EU) 2024/574', 2024) further specify the following reporting obligations in relation to the surveillance system: a species' distribution; the effectiveness and side effects of early eradication measures; the effectiveness and side effects of management measures.

The reporting obligation regarding the species' distribution foremost concerns the distribution status in the form of distribution maps ('Commission implementing regulation (EU) 2024/574', 2024, pp. 3–4). In addition, information on the reproductive status (e.g., does a self-sustaining population exist?), the reproductive pattern (e.g., sexual vs. asexual), the introduction (e.g., how was the species predominantly introduced during the reporting period?) and spread patterns (e.g., did the species predominantly disperse through natural dispersal?) is also considered a relevant aspect of distribution and should be supplied if known.

The effectiveness of early eradication measures and the effectiveness of management measures (i.e., eradication, control, containment) are both to be reported in terms of long- or short-term effects on the presence of a species or on numbers of individuals ('Commission implementing regulation (EU) 2024/574', 2024, pp. 7, 10). To this end, a few categorical response choices are offered (e.g., complete and permanent eradication, partial eradication, no reduction in numbers). Side effects are to be reported in terms of the presence of negative effects on the environment, non-targeted species, or human health.

2.1.2 Legislation in Flanders

At the Flemish level, the Decree of the Flemish Government on the Protection and Management of Species, or, in short, the Species Decree, specifies that INBO "(…) shall coordinate the inventory of species falling within the scope of this Decree, with regard to: monitoring the state of conservation of native species;

drawing up red lists concerning native species (…); monitoring the status of invasive species and potentially invasive species" ['Decree of the flemish government of 15 may 2009' (2009); article 5, explanatory notes to article 5].[1]

Inventorying is thereby defined as "establishing the occurrence of certain species in certain areas of the Flemish region, at certain time points and in certain numbers". It is further specified that the "emphasis lies on aspects of distribution, abundance changes over time (…) with regard to (…) control and the prevention of nuisance. Monitoring in turn is defined as inventorying in a"standardized and regular manner" allowing for the determination of trends with regard to the respective species. It is highlighted that inventory obligations originate in European legislation.

The "coordinating role" assigned to INBO concerns ensuring the "correct collection, processing and interpretation of data" while individual volunteers as well as volunteers from various associations and organisations might contribute to carrying out data collection in the field.

2.2 SURVEILLANCE AND MONITORING: A CLARIFICATION OF TERMS

Although used recurrently, the terms "surveillance" and "monitoring" are not explicitly defined, neither in the Invasive Alien Species Regulation nor in the Species Decree. We therefore include a brief clarification of terms in this section.

2.2.1 Surveillance and monitoring in EU terms

In the supporting document Surveillance of Invasive Alien Species of Union concern (Working Group on Invasive Alien Species, 2017) authored by the Working Group on IAS, one of the authorities/bodies supporting the EU Commission with the Invasive Alien Species Regulation's implementation , surveillance is defined as "a systematic activity or survey of entry points for IAS aimed at detecting, identifying and locating alien species new to the EU, to a Member State (…). As such, surveillance is an integral and pivotal element of early detection, early warning and rapid response and of prevention. IAS surveillance may include the adaptation or extension of existing programmes that are called 'monitoring'. Inspection may be considered a form of directed surveillance. Inspection is an official and systematic activity focused on IAS pathways and entry points or invasion hubs aimed at detecting deliberate or inadvertent introduction of IAS." (Working Group on Invasive Alien Species, 2017, p. 5).

Hence, surveillance in the EU sense pertains to the detection of previously absent IAS, via biodiversity monitoring but also official inspections.

Monitoring on the other hand is defined more broadly as "the systematic collection of data over time and space to track changes. In the IAS context this means assessing trends in new biological invasions, tracking the invasion progress of a species, or tracking biological responses to implemented actions, including eradication and control" (Working Group on Invasive Alien Species, 2017, p. 5).

2.2.2 Surveillance and monitoring in this report

In the current report, we employ "monitoring" as an umbrella term with a definition largely overlapping with the one in the above-cited EU document. Note however that, according to our use, monitoring can also be implemented for the purpose of detection, but does then obviously not incorporate official inspections. We find that a more in-depth definition is not required in the current stage.

[1] Note that this and all following quotes represent unofficial translations of the original Dutch text.

However, as we also aim to prepare future applications of the INBO guidelines for monitoring schemes to invasive species, we already point out that these guidelines handle different, more nuanced definitions of monitoring and surveillance. In the guidelines - but also in the scientific literature on nature conservation - surveillance concerns repeated and standardized measurements in order to assess the status and/or trend of a certain target, in the present context for instance the distribution of an IAS. Monitoring in turn is defined as a special form of surveillance in that it involves a-priori defined standards for the evaluation of the target's status and/or trend (Alexander, 2008, p. 49; Wouters *et al.*, 2008, pp. 15–16). Following this logic, we might, alternatively, have used "surveillance" as our umbrella term. In fact, we still were when designing the survey, which is why the raw survey materials provided in Appendix A feature the term "surveillance" instead of "monitoring". Switching terms is obviously not ideal but the benefits seemed to outweigh the costs as the EU-aligned, narrow definition of surveillance is rather common among IAS experts and in communication with policy-makers.

2.2.3 Monitoring schemes according to this report

With "monitoring schemes" we refer to schemes that have been designed following a principled methodology to ensure that data collection is purposeful and optimized to meet numerical quality criteria. Such schemes give rise to objective, reliable and valid results that are fit for informing policy. The INBO guidelines for designing policy-oriented monitoring schemes (Wouters *et al.*, 2008) represent such a methodology aimed at tailoring monitoring objectives, data collection, processing and analysis, reporting and quality control to the true information needs.

More specifically, a systematic, five-phase approach is proposed. The guidelines thereby emphasize the importance of, first, outlining a future monitoring scheme by defining monitoring objectives in collaboration with clients and stakeholders to ensure the scheme is relevant and supported, taking into account existing knowledge and data. The objectives are then translated into specific, measurable targets, with careful selection of indicators; a study design is developed that aligns the dimensioning of the scheme, as well as sampling and data collection strategies with the intended monitoring purpose; costs are estimated. The focus is then shifted to the future output of a monitoring scheme. This includes planning the storage, processing and statistical analysis of the to be collected data, but also planning the reporting and communication of monitoring results. Finally, the guidelines highlight the need for quality assurance and transparent documentation to maintain scientific credibility. They also promote regular assessments and adaptive improvements based on new insights and changing information needs.

2.3 DISTINGUISHING DIFFERENT MONITORING SCOPES

In the present IAS context a number of distinct monitoring scopes can be identified, each reflecting different objectives and being relevant for different stages of invasion. We distinguish the scopes:

- Detection
- Distribution (change)
- Abundance (change)
- Distribution (change) under management
- Abundance (change) under management

An additional scope is introduced for situations where the current or potential distribution area of a species is largely unknown. In such cases, setting up a scheme to monitor (changes in) the distribution or abundance of a species is complicated by the fact that the monitoring area is partly unknown. The primary scope then becomes to systematically establish the (potential) distribution area of a species - which is referred to as:

- Inventory

The choice of monitoring scope strongly influences the design of a monitoring scheme and is therefore an important first step in any concrete planning process. Below, we provide brief descriptions of each scope. We also summarize the key implications of the relevant legal frameworks discussed above - focusing primarily on the Invasive Alien Species Regulation, as the Flemish Species Decree remains comparatively generic in its provisions with regard to monitoring.

2.3.1 Detection

A monitoring scheme with scope detection aims to assess a species' presence in a defined area from which the species is (largely) absent. Typically this encompasses areas at (and/or around) known places of (potential) introduction or sites of sporadic occurrence. Other plausible options are areas at (and/or around) conservation sites, or areas from which the species had been eradicated before.

Detection receives considerable attention in the Invasive Alien Species Regulation. It is, for example, emphasized that prevention is "generally more environmentally desirable and cost-effective than reaction after the fact" ('Regulation (EU) no 1143/2014', 2014, p. 3) and should therefore be prioritised. Early detection and rapid response are widely recognized as pillars of effective IAS management, as they offer the best chance to contain or eradicate emerging populations before they become widespread and difficult to control. According to documentation supporting the regulation (Section 2.2.1), detection can refer to both official inspections at points of entry - such as import controls, which in Belgium fall under the responsibility of the federal government - or to monitoring of the natural environment for signs of new introductions. In this report, we focus on the latter, detecting emerging IAS populations in the wild in Flanders, as only this falls under INBO's monitoring obligations (link).

2.3.2 Distribution

Under the scope distribution, a monitoring scheme aims to assess the status of and, where relevant, trend in a species' distribution. The area to be monitored will depend on the species' current invasion stage. For species already widespread, this may require coverage of the entire Flemish region, while for species established more locally, monitoring can focus on their current range and the surrounding areas where spread is most likely. Setting up a monitoring scheme with this scope thus requires the (potential) distribution area of a species to be largely known a-priori.

Reconsidering the reporting obligations under the Invasive Alien Species Regulation, scope distribution can be considered the most well-defined from the EU perspective: distribution is explicitly operationalised as the presence and absence in terms of 10×10 km grid cells of the EEA Reference grid (Peifer, 2011) across Flanders.

2.3.3 Abundance

A monitoring scheme with the scope abundance aims to assess the status of and, where relevant, trend in a species' population size. The monitoring area will typically encompass the species' current distribution area and surrounding regions where population changes are expected. It may also involve locations of particular interest, such as invasion hotspots or areas where management actions are being implemented. We discuss this latter special case under a distinct scope, namely abundance under management.

Note that the Invasive Alien Species Regulation mentions the scope abundance only in the context of management evaluation. As with distribution monitoring, sufficient knowledge of the species' distribution area is needed to define where abundance should be monitored.

2.3.4 Distribution or abundance under management

Monitoring schemes with scopes distribution or abundance under management aim to assess the status and possibly trend of a species' distribution or population size in and around areas where management takes place. Management evaluation ranges on a continuum with as end points estimating causal effects of a measurement action versus measuring its temporal and spatial correlates. The degree of experimental and/or statistical control determines the position on this continuum. In addition, the nature of the to be evaluated management action (e.g., eradication vs. population control) further defines the implementation of the management-related scopes. If population control or containment measures are to be evaluated, the duration of monitoring will for instance be (potentially) unlimited. If eradication measures are to be evaluated, monitoring will typically be of limited duration. Once monitoring has continued for a sufficiently long period without detections to confidently confirm the species' eradication, it may be discontinued. In such cases, the focus may shift to periodic detection monitoring to ensure early warning in case of reintroduction.

The Invasive Alien Species Regulation considers distribution and abundance as possible outcomes under the monitoring of management, as well as possible side effects on non-target species and environment.

2.3.5 Inventory

Monitoring the distribution or abundance of a species requires knowledge of the (potential) distribution area of a species, as we have explained in the previous sections. If the (potential) distribution area is not sufficiently known then assessing its location forms a distinct monitoring scope called inventory (De Knijf *et al.*, 2014). Under this scope, monitoring is of limited duration and can be finalized once the status of the distribution areas is sufficiently known. Note that "inventory" as used here refers specifically to targeted, time-limited efforts to determine a species' distribution area, and differs from the broader use of the term in the Species Decree of the Flemish Government, where it includes a much wider range of monitoring objectives (see Section 2.1).

3 THE EXPERT SURVEY

In this chapter, we recapitulate the purpose and describe the design of the expert survey, including the selection, format and scoring of questions and the generation and distribution of questionnaires. We also detail how the survey results were used for prioritising species-scope combinations for further planning.

3.1 PURPOSE

To support the early phase-planning of structured IAS monitoring schemes for Flanders, we conducted a survey drawing on the knowledge of species experts. The survey aimed to obtain context-specific information on individual species' invasion stage, introduction, distribution, abundance and impacts in Flanders, as well as ongoing management actions, and available monitoring techniques. This combined need for context-specific information and expert judgement motivated the use of a survey approach rather than a literature review. Existing publications may lack the geographical specificity, operational detail, or up-to-date insights required for monitoring design in the Flemish context. Also, for relevant publications, we expected species experts to be aware and draw on them where appropriate. The survey therefore included questions to assess the perceived urgency and feasibility of establishing monitoring schemes for each species, considering the above-mentioned aspects.. The expert assessments formed the input for the prioritisation process to identify a limited number of priority species and monitoring schemes. The survey covers all 114 IAS of Union concern and an additional set of 8 species that were at the time of survey set-up considered as candidates for the 2025 extension of the Union List. For a complete overview of the 122 species covered see Section A.1.[1]

3.2 DESIGN

3.2.1 Question selection and question format

To provide a comprehensive overview, questions from different categories were posed, concerning a species' introduction and establishment, distribution and abundance, impact, monitoring, and management. The questionnaire was structured around these thematic sections to capture expert knowledge across all possible invasion stages and to provide a multi-criteria basis for prioritisation in subsequent planning. More specifically, the following aspects are covered per section:

- Introduction and establishment
  - Configuration introduction sites?
  - Introduction sites accessible?
  - Probability of introduction?
  - Probability of establishment?
  - Special introduction sites?
- Distribution and abundance
  - Distribution known?

[1]Since the survey was set up before the most recent update of the Union List ('Commission implementing regulation (EU) 2025/1422', 2025), it was originally sent out for 88 Union List and 34 candidate species. We have however adapted the current report to reflect the 2025 Union List status. Information on the 2022 situation is still included in the referenced species overview table in Appendix A.

  - Distribution pattern?
  - Which population density?
  - Change in distribution sites?
  - Distribution sites accessible?
  - Special distribution sites?
- Impact
  - Impact biodiversity?
  - Impact biodiversity conservation areas?
  - Impact other sectors?
- Monitoring
  - Which monitoring techniques?
  - Most relevant monitoring technique?
  - Sensitivity monitoring technique?
  - Specificity monitoring technique?
  - Cost monitoring technique?
  - Scope monitoring technique?
  - Field protocol available?
  - Relevant monitoring schemes?
  - Opportunistic observations representative?
- Management
  - Species managed?
  - Information management evaluation?

In the beginning of each questionnaire experts were asked to indicate the invasion status for the species and questionnaire composition then dynamically adapted to this input: depending on whether the species was marked as "absent," "sporadically present," "established to a limited extent," or "widespread," certain questionnaire sections were shown or skipped. If a species was reported as established to a limited extent or widespread, we considered questions belonging to the section on introduction and establishment irrelevant and omitted these. If a species was reported as absent, questions on the distribution and abundance in Flanders were skipped.

Questions were of both closed, multiple-choice and open, free-text format. Each closed question was paired with an open one allowing respondents to complement their selection of the a-priori defined response option/the forced standardized replies with contextual clarifications. A full overview of all questions in the original survey composition is included in Section A.2.

3.2.2 Question scoring

All closed questions are formulated such that they function as indicators of either feasibility or urgency of a monitoring scheme for the species under consideration. Lower or higher levels of feasibility or urgency are encoded via numerical scores assigned across the response options of each question. Score values range from 1 indicating low feasibility or urgency to 4 indicating high feasibility or urgency, and are treated as interval-scaled in subsequent analyses. Different response options can have the same score, but all scores are assigned at least once per question. Scores were set a-priori to distributing the survey but not visible to respondents. Table 3.1 illustrates the scoring of questions by providing the key that links response options to scores per question.

Take, for example, species not yet present in Flanders for which early detection is essential. Experts were asked to evaluate how potential introduction sites for such species are configured. If the number of introduction sites is limited and sites are specific (e.g. seaports), monitoring all of these sites is considered highly feasible and the largest value is assigned. Instead, if introduction sites are many and widespread (e.g., for a species that is expected to mainly be released from aquaria into freshwater bodies in Flanders) feasibility of structured monitoring is considered to be comparatively low and a small value is assigned. The smallest value (and thus lowest feasibility) is assigned if experts report the (potential) introduction sites as unknown, to them personally or generally. The underlying rationale is that the feasibility of planning monitoring schemes is minimal if the relevant information is unavailable. We apply this rather conservative scoring strategy to all questions as can be seen in the table.

Table 3.1: Scoring of the survey questions

Question (indicator)	Score	Response option
Introduction and establishment		
Configuration introduction sites? (f)	1	unknown / I do not know
	2	large number of widespread locations (e.g. freshwater bodies if the species is mainly released from aquaria)
	3	both specific and widespread locations
	4	limited number of specific locations (e.g. seaports)
Introduction sites accessible? (f)	1	unknown / I do not know
	2	mainly publicly non-accessible domains (e.g. private, commercial, military domains)
	3	both publicly accessible and non-accessible domains
	4	mainly publicly accessible domains
Probability of introduction? (u)	1	unknown / I do not know
	2	small probability
	3	medium probability
	4	large probability
Probability of establishment? (u)	1	unknown / I do not know
	2	small probability
	3	medium probability
	4	large probability
Distribution and abundance		
Distribution known? (f)	1	no, the distribution is not sufficiently known / I do not know
	3	yes, the distribution is sufficiently known but the distribution map is not representative of it
	4	yes, the distribution is sufficiently known and the distribution map is representative of it
Distribution pattern? (f)	1	unknown / I do not know
	2	the species is widespread and can thus found at many sites in Flanders
	3	the species is locally distributed but could potentially spread widely across Flanders
	4	the species is locally distributed and may also only occur at a limited number of sites in Flanders
Which population density? (f)	1	unknown / I do not know
	2	the species has reached, or has the potential to reach, a medium population density
	3	the species has reached, or has the potential to reach, a low population density
	4	the species has reached, or has the potential to reach, a high population density
Change in distribution sites? (f)	1	unknown / I do not know
	2	large change expected (many additional distribution sites, change in distribution pattern from local to widespread)
	3	medium change expected (medium number of additional distribution sites)
	4	small change expected (few additional distribution sites)
Distribution sites accessible? (f)	1	unknown / I do not know
	2	mainly publicly non-accessible domains (e.g. private, commercial, military domains)
	3	both publicly accessible and non-accessible domains
	4	mainly publicly accessible domains
Impact		
Impact biodiversity? (u)	1	not applicable as species is unlikely to become invasive in Flanders within 10 years / unknown / I do not know
	2	small negative impact expected
	3	medium negative impact expected
	4	large negative impact expected
Impact biodiversity conservation areas? (u)	1	not applicable as species is unlikely to become invasive in Flanders within 10 years / unknown / I do not know
	2	mainly outside conservation or Natura 2000 areas
	3	both inside and outside conservation or Natura 2000 areas
	4	mainly in conservation or Natura 2000 areas
Impact other sectors? (u)	1	not applicable as species is unlikely to become invasive in Flanders within 10 years / unknown / I do not know
	2	medium negative impact expected
	3	small negative impact expected
	4	large negative impact expected
Monitoring		
Sensitivity monitoring technique? (f)	1	unknown / I do not know
	2	low sensitivity
	3	medium sensitivity
	4	high sensitivity
Specificity monitoring technique? (f)	1	unknown / I do not know
	2	low specificity
	3	medium specificity
	4	high specificity
Cost monitoring technique? (f)	1	unknown / I do not know
	2	high costs
	3	medium costs
	4	low costs
Field protocol available? (f)	1	no / unknown / I do not know

(continued)

Question (indicator)	Score	Response option
	2	yes, but the field protocol is only standardised / yes, but the field protocol is only optimised
	4	yes
Opportunistic observations representative? (u)	1	unknown / I do not know
	2	low representativeness
	3	medium representativeness
	4	high representativeness
Management		
Species managed? (u)	1	no / unknown / I do not know
	4	yes

3.2.3 Questionnaire generation and distribution

For each species, a separate questionnaire was set up using Google Forms. We opted for species-specific forms because we wanted to include species-specific information (e.g., scientific names, distribution maps based on recent data from the Global Biodiversity Information Facility (GBIF) (GBIF.Org User, 2024; The Global Biodiversity Information Facility, 2025), see Section A.4). The only exception was the group of three invasive knotweeds, which were combined into a single form. This decision was based not only on their similar ecological characteristics, but primarily on the difficulty of reliably distinguishing them in the field or in most data sources.

Questionnaires were generated and distributed in a semi-automated workflow involving R and Google Apps Script scripts, all available via the github repository inbo/mias-general (Adolf, s.d.).

The 120 generated forms were mapped to 57 experts affiliated with INBO as well as other research institutions in Belgium and the Netherlands. Links to the forms were sent out via e-mail using a standardized text (see Section A.3).

3.3 PRIORITISATION OF SPECIES-SCOPE COMBINATIONS

Crossing the different monitoring scopes described in Chapter 2 with all 122 species covered in the expert survey results in a large number of potential monitoring schemes. To make the development of monitoring schemes tractable, a prioritisation must be made. The desired outcome of this prioritisation process was thus to arrive at a limited number of relevant high-priority species and monitoring scope combinations. These priority combinations form the starting point for the development of structured, policy-relevant IAS monitoring schemes, to be implemented using the proven INBO framework for monitoring design and evaluation (Wouters *et al.*, 2008).

Our approach to the prioritisation involves a two-stage exclusion process visualized in Figure 3.1. First we exclude species-scope combinations that are less relevant. Then we exclude species-scope combinations that have low priority. We base exclusion not only on the overall feasibility and urgency scores, but also on responses to selected individual survey questions. The latter implies that a species-scope combination is excluded if the expert chooses a certain response to a certain question - an implementation of the one-out-all-out-principle for a limited number of question-response combinations we deemed critical. We detail the two stages of the prioritisation process and the exact exclusion criteria employed in the following.

It is important to note that the prioritisation process necessarily involves interpretative choices - such as how to best define exclusion criteria - which may be open to debate. The results presented here are intended to inform decision-making by the steering committee, which retains the flexibility to revisit or adjust priorities in light of the expert survey findings and additional considerations (see Chapter 5).

Also note that prioritisation is not to be understood in the sense of (re-)determining the relevance of IAS in general. It concerns a temporary ranking of species-scope combinations in order to organise the - to some extent necessarily - sequential planning of IAS monitoring schemes.

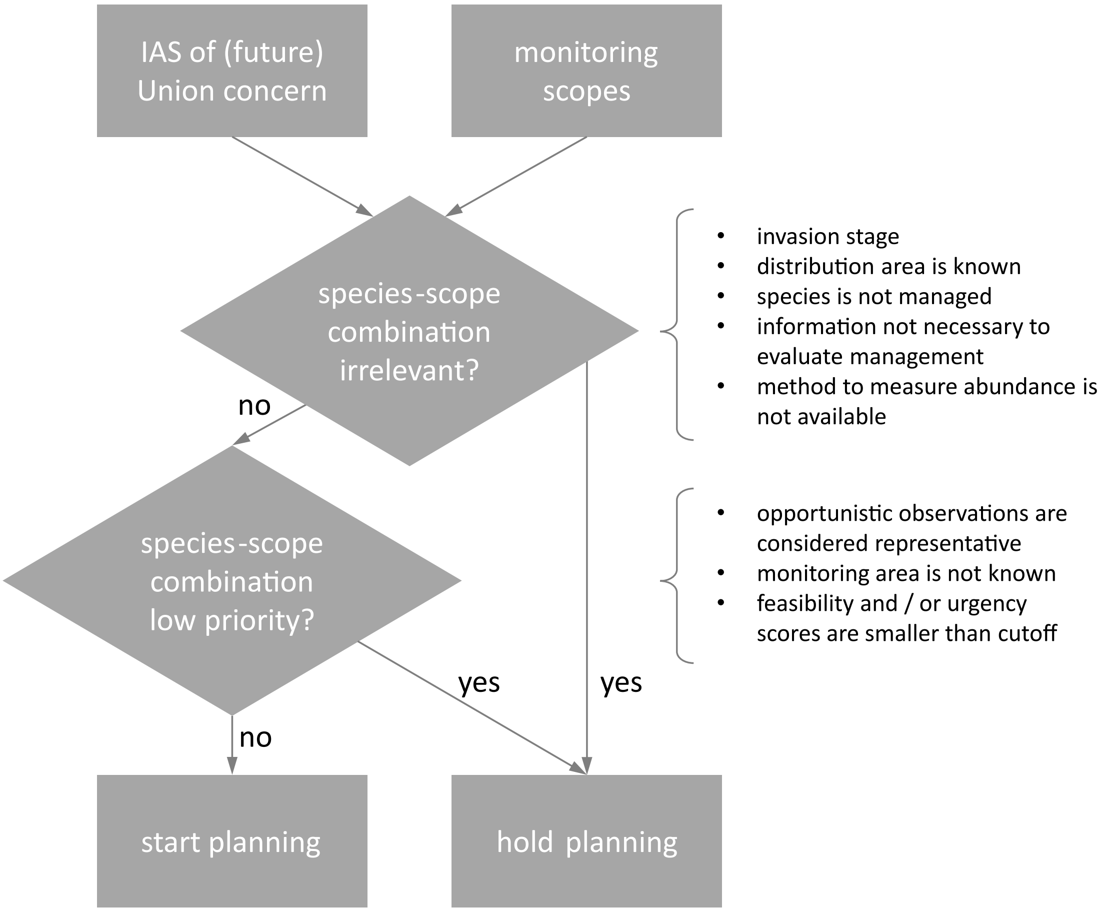

Figure 3.1: Flowchart of the prioritisation process

3.3.1 Stage 1: exclusion of irrelevant/less relevant species-scope combinations

In Stage 1 of the prioritisation process, we exclude species-scope combinations that are less relevant. We determine relevance based on

- the invasion stage of a species,
- whether the monitoring area is known,
- whether the species is managed,
- which information is necessary to evaluate management,
- whether suitable methods are available to implement the monitoring.

We explain each criterion in the following sections. For the exact filtering rules applied to the survey data see R code here.

3.3.1.1 Invasion stage

First, the relevance of a given monitoring scope depends on the invasion stage of a species. Not all scopes are meaningful or appropriate for each stage. For species that are absent or only sporadically present, detection is the only relevant scope, as the objective is to identify new introductions early. For species that are established to a limited extent, relevant scopes may include inventory, distribution (under management), and abundance (under management). At this stage, we consider detection less relevant, since the species is already locally present. For widespread species, inventory is not considered necessary, as the species' general distribution is assumed to be sufficiently known. There is one important exception where detection may still be relevant at this stage. As emphasized by D'hondt *et al.* (2022), a species classified as widespread across Flanders may still be absent from specific high-value conservation areas. In such cases, it may be worthwhile to invest in detection efforts targeted specifically at these areas, in order to prevent establishment in ecologically sensitive sites where the species is expected to have a significant impact. In addition to this specific form of detection, distribution (under management) and abundance (under management) remain relevant scopes for widespread species, particularly in the context of ongoing or planned control measures.

3.3.1.2 Knowledge of the distribution area

Second, scope relevance also depends on whether the distribution area of a species is known. If the distribution area is reported as known, then the scope inventory is irrelevant, if it is unknown, inventory is required and thus retained. This criterion only concerns limitedly established species as this is the only invasion stage for which we withhold scope inventory.

3.3.1.3 Current management of the species

A third factor to determine scope relevance is the existence of management. If a species is currently not managed, then management-related monitoring is irrelevant.

3.3.1.4 Information necessary to evaluate management

Fourth, scope relevance depends on the kind of information necessary to evaluate management if the species is managed. If presence-absence information is sufficient, then management-related monitoring using abundance information is irrelevant If abundance information is required, then management-related monitoring using distribution information is irrelevant

3.3.1.5 Availability of suitable monitoring technique

Even if a particular monitoring scope is relevant for a species based on the previously discussed criteria, it may still be excluded from further consideration if no suitable methods are available to implement it. We consider a method unsuitable when it cannot measure the outcome required by the scope in question. In the survey, experts were asked to indicate which monitoring technique they considered most relevant for the species in question, and, subsequently, whether that technique could measure relative or absolute abundance. If the selected technique was only capable of assessing presence or absence, we deemed the abundance-related scopes infeasible. Although experts could also list additional potentially relevant techniques, follow-up questions targeting their characteristics were only posed for the technique identified as most relevant.

3.3.2 Stage 2: exclusion of low priority species-scope combinations

In Stage 2 of the prioritisation process, we further filter the retained relevant species-scope combinations by excluding low priority instances. We determine priority based on

- whether opportunistic observations cover a scope,
- whether the monitoring area is unknown or unspecific for a species,
- whether the expert-judged overall feasibility and urgency reach critical values.

We again explain each criterion in the following sections. For the exact filtering rules applied to the survey data see R code here.

3.3.2.1 Representativeness of opportunistic data

First, we check whether species-scope combinations can be considered covered by opportunistic observations (e.g. observations recorded via waarnemingen.be, 'Waarnemingen.be', s.d.). If for a species opportunistic observations are considered highly representative by the expert, all scopes retained for this species are marked as having low priority.

3.3.2.2 Knowledge and specificity of the monitoring area

Second, we take into account whether the monitoring area is known for a species. The monitoring area can refer to different things depending on the invasion stage of a species. For absent or sporadically present species it concerns introduction places and scope detection is marked as having low priority if the introduction places are reported as unknown or unspecific (i.e., a large number of widespread locations). For sporadically present species the distribution area needs to be known in addition. If the distribution area is reported as unknown for limitedly established species, the distribution- and abundance-related scopes are marked as low priority, while the inventory scope is marked as high priority. The distribution- and abundance-related scopes were retained as relevant during the first exclusion round, as scope inventory requires a temporary monitoring effort only, and the remaining scopes should then become prioritised.

3.3.2.3 Overall feasibility & urgency scores

Finally, we consider the survey's response scores reflecting the expert-judged overall feasibility and urgency per species. We calculate these overall scores as the arithmetic means across all feasibility- and urgency-indicator questions, respectively. As critical values we in each case use the 50th percentile (i.e., the median) of the distribution of the overall scores across all species. Per se, the 50th percentile is a rather liberal choice for a critical value, but in the present process less decisive as it is complemented by additional exclusion criteria.

For a given species we assign a high priority only if both the overall feasibility and urgency scores are larger than their respective critical values. Otherwise all scopes retained up to now are excluded for this species.

3.3.3 Reporting format

3.3.3.1 Table of species-scope combinations

To report the results of the prioritisation process we present all species-scope combinations in the form of a table where rows pertain to species and columns to scopes. Table 3.2 illustrates this format.

For a species-scope combination retained after the entire prioritisation process, the corresponding table cell holds the monitoring methods reported for this species. For a species-scope combination excluded during the second stage of the prioritisation process, the monitoring methods are greyed out and the table cell additionally holds a symbol indicating the reason(s) for exclusion. For a species-scope combination excluded during the first stage of the prioritisation process, the corresponding table cell only holds a symbol indicating the reason(s) for exclusion.

3.3.3.2 Table of monitoring method-based synergies

We complement the table of species-scope combinations with a table of potential monitoring method-based synergies. That is, within each monitoring scope, we identify species for which overlapping methods were reported and display those in tabular fashion. Such method-based commonalities may help to align efforts in the planning of monitoring schemes (e.g., method selection, planning of data collection) or even in their future implementation (e.g., training field workers, data analysis, joint procurement and logistics). It is important to note, however, that the present analysis represents a preliminary screening. Whether the indicated synergies actually manifest will only become clear upon further investigation during the application of the INBO guidelines for designing monitoring schemes.

We consider method-based synergies in two ways: first, between species for which a given scope was retained during both stages of the prioritisation process, referred to as primary species in the following; and second, between primary species and species for which the scope remained relevant but was given a low priority during the second exclusion round. Here we further distinguish between secondary and tertiary species. Secondary species are those excluded purely due to a low overall urgency score, despite being considered feasible to monitor; tertiary species have been excluded purely due to a low overall feasibility score, even though the overall urgency of monitoring was critical. Non-primary species can still be relevant to consider if they share monitoring methods with primary species. In such cases, they may be included as potential “free riders” in that they could be monitored opportunistically as part of a scheme primarily designed for a primary species.

Table 3.2: Illustration of the prioritisation results presentation

Species	Invasion stage	Scope					
		Detection	Inventory	Distribution	Abundance	Distribution management	Abundance management
species A	absent	×, method A	∘	∘	∘	∘, †	∘, †
species B	absent	×, method A	∘	∘	∘	∘, †	∘, †
species C	absent	**, method A	∘	∘	∘	∘, †	∘, †
species D	sporadically present	**, method A	∘	∘	∘	∘, †	∘, †
species E	established to limited extend	∘	#	△, method A	△, method A	†	†
species F	established to limited extend	∘	#	**method A**	**method A**	†	†
species G	established to limited extend	∘	#	**, method A	**, method A	†	†
species H	established to limited extend	∘	**method A**	**method A**	**method A**	†	†
species I	established to limited extend	∘	#	**method A**	**method A**	‡	**method A**
species J	established to limited extend	∘	#	**method B**	**method B**	**method B**	‡
species K	established to limited extend	∘	#	**, method B	**, method B	‡	**, method B
species L	widespread	**method B**	∘	**method B**	**method B**	†	†
species M	widespread	∘	∘	**method B**	⊥	†	†, ⊥
species N	widespread	∘	∘	**method B**	**method B**	†	†

° scope not relevant due to invasion stage
\# scope not relevant as distribution area is known
† scope not relevant as species is not managed
‡ scope not relevant as information not necessary to evaluate management
⊥ scope not relevant as method to measure abundance is not available
△ scope low priority as opportunistic observations are considered representative
× scope low priority as monitoring area is not known
** scope low priority as both feasibility and urgency scores are smaller than cutoff
$u*$ scope low priority as urgency score is larger but feasibility score is smaller than cutoff
$f*$ scope low priority as feasibility score is larger but urgency score is smaller than cutoff

4 RESULTS OF THE EXPERT SURVEY

In this chapter, we present the results of the expert survey. This mainly concerns the results of the prioritisation process but also a number of descriptive results. All R analysis code is again available via the github repository inbo/mias-general (Adolf, s.d.).

4.1 DESCRIPTIVE RESULTS

4.1.1 Response rate

Of the 120 questionnaires 105 were completed for 107 species. Among these species are 99 IAS of Union concern and 8 additional species.[1] At the time we started processing the survey data, the survey was not completed for the following Union List IAS:

- *Andropogon virginicus L. [EN: broom-sedge, NL: Amerikaans bezemgras]*
- *Broussonetia papyrifera (L.) L'Hér. ex Vent. [EN: paper mulberry, NL: papiermoerbei]*
- *Cabomba caroliniana A.Gray [EN: Carolina water-shield, NL: waterwaaier]*
- *Cervus nippon Temminck, 1838 [EN: sika deer, NL: sikahert]*
- *Ehrharta calycina Sm. [EN: perennial veldtgrass, NL: roze rimpelgras]*
- *Gymnocoronis spilanthoides DC. [EN: Senegal tea plant, NL: smalle theeplant]*
- *Heracleum mantegazzianum Sommier & Levier [EN: cartwheel-flower, NL: reuzenbereklauw]*
- *Heracleum persicum Desf. [EN: Persian hogweed, NL: Perzische berenklauw]*
- *Hydrocotyle ranunculoides L.fil. [EN: floating pennywort, NL: grote waternavel]*
- *Impatiens glandulifera Royle [EN: Himalayan balsam, NL: reuzenbalsemien]*
- *Pistia stratiotes L. [EN: lettuce water, NL: watersla]*
- *Sciurus carolinensis Gmelin, 1788 [EN: eastern grey squirrel, NL: grijze eekhoorn]*
- *Sciurus niger Linnaeus, 1758 [EN: fox squirrel, NL: Amerikaanse voseekhoorn]*
- *Threskiornis aethiopicus (Latham, 1790) [EN: African sacred ibis, NL: heilige ibis]*
- *Zostera japonica Asch. & Graebn. [EN: dwarf eelgrass, NL: Japanese eelgrass]*

In the overview table Table A.1, species entries are greyed out if the survey was sent out but not completed.

4.1.2 Overall feasibility and urgency scores

Species' overall feasibility and urgency scores obtained from the survey can be explored in Figure 4.1. The figure displays the overall scores along the x-axis and the species along the y-axis. Triangles represent feasibility and circles urgency scores and species are sorted according to their overall feasibility scores and nested within these according to their overall urgency scores. The critical feasibility and urgency values used for exclusion in the prioritisation process are indicated via vertical lines (dashed for urgency, solid for feasibility). Per species, overall feasibility and urgency scores are connected by a solid line if they exceed

[1] For the scientific species names, we based ourselves on the currently accepted scientific names according to GBIF (The Global Biodiversity Information Facility, 2025). This has led to the following error: On GBIF the Union List species *Misgurnus bipartitus (Sauvage & Dabry de Thiersant, 1874)* is listed as a synonym of the non-Union List species *Misgurnus mohoity (Dybowski, 1869)*, which thus also classifies as the accepted scientific name. The survey results thus pertain to *Misgurnus mohoity (Dybowski, 1869)* instead of *Misgurnus bipartitus (Sauvage & Dabry de Thiersant, 1874)*. Unfortunately, this error was missed during checks of the species list and only noted during review.

both their critical values and by a dashed line otherwise. Triangles or circles that are filled pertain to Union List species, empty ones to candidate species. The expert-judged invasion stage is coded by colour: absent species are shown in grey, sporadically present species in orange, limitedly established species in magenta, and widespread species in purple.

We see that monitoring schemes tend to be rated as both more urgent and feasible for species in later invasion stages. This is in part related to the fact that, for species in earlier invasion stages, experts tended to reply "unknown" or "I don't know" more often - response options that we linked to low feasibility and urgency (see Section B.1). Also, we find more often that feasibility scores are higher than urgency scores than the reverse.

As explained in Section 3.3, the displayed overall scores co-determine the prioritisation results: species that miss either the critical feasibility or the critical urgency value are excluded from the final prioritisation. Species that pass both critical values are included, unless they are excluded due to other, more specific reasons linked to expert reactions to individual questions.

4.1.3 Additional results

A number of additional descriptive results and corresponding visualizations are included in Section B.1. These provide more detailed insights into experts' evaluations. We for instance show to what extent the expert-judged invasion stage matched the one established in the PrIUS report (D'hondt *et al.*, 2022), how often experts indicated the response to a question as unknown (to them) per species or question, which monitoring techniques were reported with which frequencies and in which combinations, and which existing monitoring efforts were reported per species.

4.2 RESULTS OF THE PRIORITISATION PROCESS

4.2.1 Prioritisation of all species covered

Table 4.1 and Table 4.2 display the results of the survey-based prioritisation process for all plants and animals assessed in the survey in the form of the above introduced species-scope table (see Section 3.3.3.1). The tables are sorted as follows. First, rows are sorted by monitoring scope priority (stage 2 of prioritisation process), with high priority scopes on top. Within (i.e., for each value of) scope priority, rows are sorted by scope type relying on the order: detection, inventory, distribution, abundance, distribution_management, abundance_management. That is, within high and low priority scopes, all species for which (at least) detection is relevant appear first, followed by those for which (at least) inventory is relevant and so forth. Within (i.e., for each value of) scope type, rows are sorted by milieu according to the order: freshwater, freshwater, brackishwater, freshwater, brackishwater, marine, freshwater, terrestrial, terrestrial, terrestrial, brackishwater, terrestrial, freshwater, brackishwater, marine, marine, brackisch, freshwater, brackishwater, marine. Within (i.e., for each value of) milieu, rows are sorted by invasion stage, from "absent" to "widely established". Within (i.e., for each value of) invasion stage, rows are sorted by global feasibility scores from high to low.

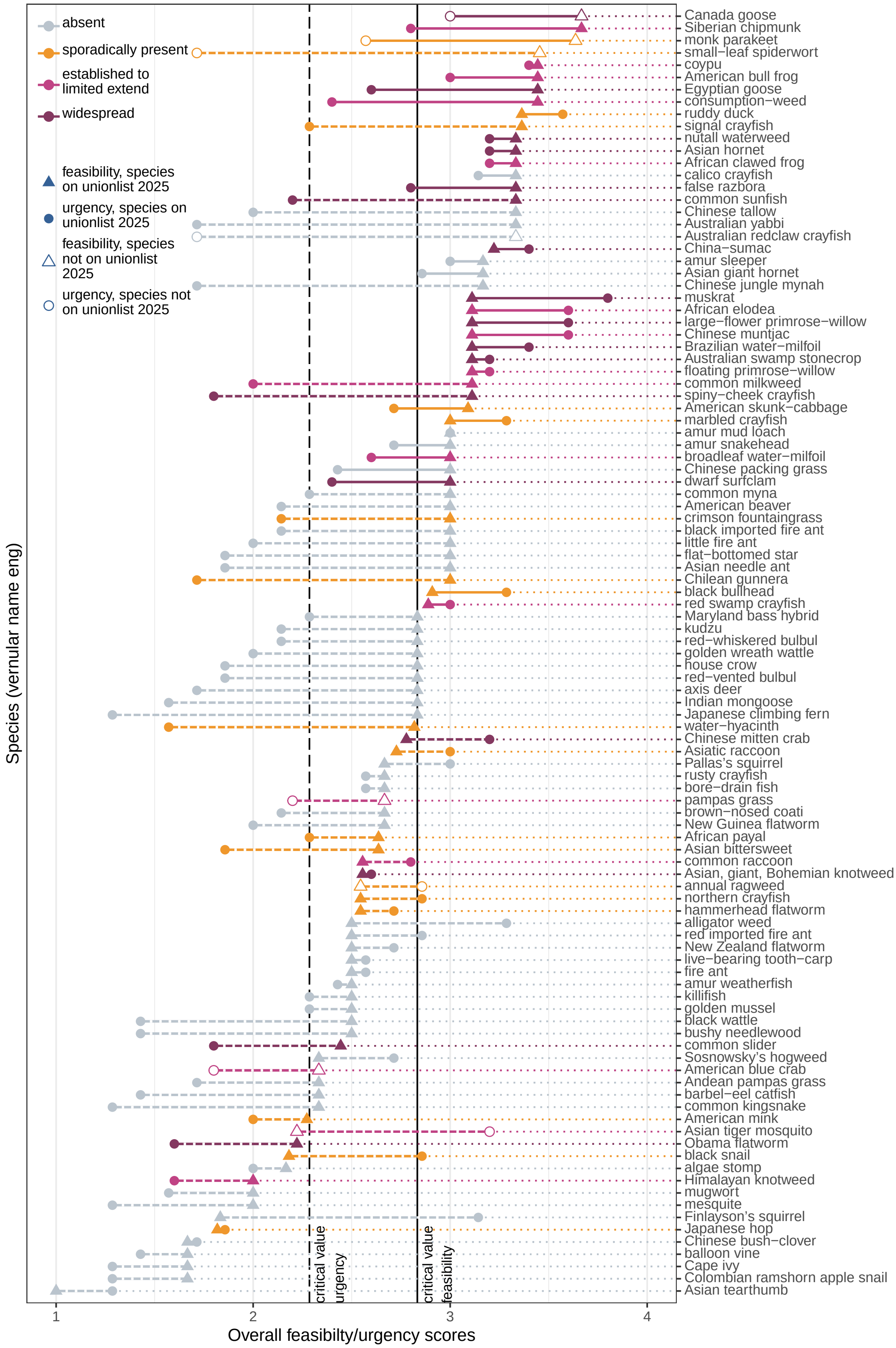

Figure 4.1: Overal feasibility and urgency scores for all species covered in the survey

Table 4.1: Prioritisation results for all monitoring scope-plant combinations covered in the survey

Species	Vern name eng	Prius milieu	Invasion stage	Scope					
				Detection	Inventory	Distribution	Abundance	Distribution management	Abundance management
Lysichiton americanus Hultén & H.St.John	American skunk-cabbage	freshwater, terrestrial	sporadically present	**visual surveys**	○	○	○	○, †, ‡	○, †
Lygodium japonicum (Thunb.) Sw.	Japanese climbing fern	terrestrial	absent	**visual surveys**	○	○	○	○, †	○, †, ‡
Ailanthus altissima (Mill.) Swingle	China-sumac	terrestrial	widespread	**visual surveys**	○	**visual surveys**	**visual surveys**	**visual surveys**	‡
Lagarosiphon major (Ridl.) Moss	African elodea	freshwater	established to limited extend	○	#	**eDNA: water, visual surveys**	**eDNA: water, visual surveys**	‡	**eDNA: water, visual surveys**
Ludwigia peploides (Kunth) P.H.Raven	floating primrose-willow	freshwater	established to limited extend	○	#	**eDNA: water, visual surveys**	**eDNA: water, visual surveys**	‡	**eDNA: water, visual surveys**
Ludwigia grandiflora (Michx.) Greuter & Burdet	large-flower primrose-willow	freshwater	widespread	○	○	**eDNA: water, visual surveys**	**eDNA: water, visual surveys**	‡	**eDNA: water, visual surveys**
Myriophyllum aquaticum (Vell.) Verdc.	Brazilian water-milfoil	freshwater	widespread	○	○	**visual surveys**	**visual surveys**	‡	**visual surveys**
Crassula helmsii (Kirk) Cockayne	Australian swamp stonecrop	freshwater, terrestrial	widespread	○	○	**eDNA: water, visual surveys**	**eDNA: water, visual surveys**	‡	**eDNA: water, visual surveys**
Pontederia crassipes Mart.	water-hyacinth	freshwater	sporadically present	×, ** , visual surveys	○	○	○	○, †, ‡	○, †
Salvinia ×molesta D.S.Mitch.	African payal	freshwater	sporadically present	×, ** , visual surveys	○	○	○	○, †, ‡	○, †
Alternanthera philoxeroides (Mart.) Griseb.	alligator weed	freshwater, terrestrial	absent	×, $u*$, eDNA: water, visual surveys	○	○	○	○, †	○, †, ‡
Triadica sebifera (L.) Small	Chinese tallow	terrestrial	absent	$f*$, visual surveys	○	○	○	○, †	○, †, ‡
Microstegium vimineum (Trin.) A.Camus	Chinese packing grass	terrestrial	absent	$f*$, visual surveys	○	○	○	○, †, ‡	○, †
Acacia saligna (Labill.) H.L.Wendl.	golden wreath wattle	terrestrial	absent	× , visual surveys	○	○	○	○, †	○, †, ‡
Pueraria montana (Lour.) Merr.	kudzu	terrestrial	absent	△ , visual surveys	○	○	○	○, †	○, †
Acacia mearnsii De Wild.	black wattle	terrestrial	absent	△, ×, ** , visual surveys	○	○	○	○, †	○, †
Hakea sericea Schrad. & J.C.Wendl.	bushy needlewood	terrestrial	absent	×, ** , visual surveys	○	○	○	○, †, ‡	○, †
Cortaderia jubata (Lemoine) Stapf	Andean pampas grass	terrestrial	absent	×, ** , visual surveys	○	○	○	○, †, ‡	○, †
Heracleum sosnowskyi Manden.	Sosnowsky's hogweed	terrestrial	absent	×, $u*$, visual surveys	○	○	○	○, †	○, †, ‡
Parthenium hysterophorus L.	mugwort	terrestrial	absent	△, ** , visual surveys	○	○	○	○, †	○, †
Prosopis juliflora (Sw.) DC.	mesquite	terrestrial	absent	×, ** , visual surveys	○	○	○	○, †	○, †
Cardiospermum grandiflorum Sw.	balloon vine	terrestrial	absent	△, ×, ** , visual surveys	○	○	○	○, †	○, †

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(continued)

Species	Vern name eng	Prius milieu	Invasion stage	Detection	Inventory	Distribution	Abundance	Distribution management	Abundance management
Delairea odorata Lem.	Cape ivy	terrestrial	absent	×, ∗∗ , visual surveys	∘	∘	∘	∘, †, ‡	∘, †
Lespedeza cuneata (Dum.Cours.) G.Don	Chinese bush-clover	terrestrial	absent	×, ∗∗ , visual surveys	∘	∘	∘	∘, †	∘, †, ‡
Persicaria perfoliata (L.) H.Gross	Asian tearthumb	terrestrial	absent	×, ∗∗ , camera and drone images, visual surveys	∘	∘	∘	∘, †	∘, †
Tradescantia fluminensis Vell.	small-leaf spiderwort	terrestrial	sporadically present	△, *f*∗ , visual surveys	∘	∘	∘	∘, †	∘, †, ‡
Cenchrus setaceus (Forssk.) Morrone	crimson fountaingrass	terrestrial	sporadically present	*f*∗ , visual surveys	∘	∘	∘	∘, †	∘, †, ‡
Gunnera tinctoria (Molina) Mirb.	Chilean gunnera	terrestrial	sporadically present	×, *f*∗ , visual surveys	∘	∘	∘	∘, †, ‡	∘, †
Celastrus orbiculatus Thunb.	Asian bittersweet	terrestrial	sporadically present	×, ∗∗ , visual surveys	∘	∘	∘, ⊥	∘, †	∘, †, ‡, ⊥
Ambrosia artemisiifolia L.	annual ragweed	terrestrial	sporadically present	△, ×, *u*∗ , eDNA: air, visual surveys	∘	∘	∘, ⊥	∘, †	∘, †, ‡, ⊥
Humulus scandens (Lour.) Merr.	Japanese hop	terrestrial	sporadically present	×, ∗∗ , visual surveys	∘	∘	∘	∘, †	∘, †
Reynoutria japonica Houtt., Reynoutria sachalinensis (F.Schmidt) Nakai, Reynoutria ×bohemica Chrtek & Chrtková	Asian, giant, Bohemian knotweed	terrestrial	widespread	△, *u*∗ , camera and drone images, visual surveys	∘	△, *u*∗ , camera and drone images, visual surveys	△, *u*∗ , camera and drone images, visual surveys	†, ‡	†
Rugulopteryx okamurae (E.Y.Dawson) I.K.Hwang, W.J.Lee & H.S.Kim, 2009	algae stomp	marine	absent	∗∗ , eDNA: water, visual surveys	∘	∘	∘	∘, †	∘, †
Myriophyllum heterophyllum Michx.	broadleaf water-milfoil	freshwater	established to limited extend	∘	△ , eDNA: water, visual surveys	△, × , eDNA: water, visual surveys	△, × , eDNA: water, visual surveys	†, ‡	†
Koenigia polystachya (Wall. ex Meisn.) T.M.Schust. & Reveal	Himalayan knotweed	terrestrial	established to limited extend	∘	∗∗ , camera and drone images, visual surveys	×, ∗∗ , camera and drone images, visual surveys	×, ∗∗ , camera and drone images, visual surveys	†, ‡	†
Elodea nuttallii (Planch.) H.St.John	nutall waterweed	freshwater	widespread	∘	∘	△ , eDNA: water, visual surveys	△ , eDNA: water, visual surveys	△ , eDNA: water, visual surveys	‡
Asclepias syriaca L.	common milkweed	terrestrial	established to limited extend	∘	#	△, *f*∗ , visual surveys	△, *f*∗ , visual surveys	†, ‡	†
Cortaderia selloana (Schult. & Schult.f.) Asch. & Graebn.	pampas grass	terrestrial	established to limited extend	∘	#	△, ∗∗ , visual surveys	△, ∗∗ , visual surveys	†	†, ‡
Baccharis halimifolia L.	consumption-weed	terrestrial, brackishwater	established to limited extend	∘	#	△, *f*∗ , visual surveys	△, *f*∗ , visual surveys	†, ‡	†

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(continued)

Species	Vern name eng	Prius milieu	Invasion stage	Detection	Inventory	Distribution	Abundance	Distribution management	Abundance management

° scope not relevant due to invasion stage
scope not relevant as distribution area is known
† scope not relevant as species is not managed
‡ scope not relevant as information not necessary to evaluate management
⊥ scope not relevant as method to measure abundance is not available
△ scope low priority as opportunistic observations are considered representative
× scope low priority as monitoring area is not known
** scope low priority as both feasibility and urgency scores are smaller than cutoff
$u*$ scope low priority as urgency score is larger but feasibility score is smaller than cutoff
$f*$ scope low priority as feasibility score is larger but urgency score is smaller than cutoff

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Table 4.2: Prioritisation results for all monitoring scope-animal combinations covered in the survey

				Scope					
Species	Vern name eng	Prius milieu	Invasion stage	Detection	Inventory	Distribution	Abundance	Distribution management	Abundance management
Ameiurus melas (Rafinesque, 1820)	black bullhead	freshwater	sporadically present	**eDNA: water, electrofishing**	◦	◦	◦	◦, ‡	◦
Perccottus glenii Dybowski, 1877	amur sleeper	freshwater, brackishwater	absent	**traps, eDNA: water, electrofishing, gill nets, trawl nets**	◦	◦	◦	◦, †, ‡	◦, †
Pseudorasbora parva (Temminck & Schlegel, 1846)	false razbora	freshwater, brackishwater	widespread	**traps, eDNA: water, electrofishing, gill nets, trawl nets**	◦	**traps, eDNA: water, electrofishing, gill nets, trawl nets**	**traps, eDNA: water, electrofishing, gill nets, trawl nets**	†, ‡	†
Ondatra zibethicus (Linnaeus, 1766)	muskrat	freshwater, terrestrial	widespread	**camera traps, eDNA: water, trace research, visual surveys**	◦	**camera traps, eDNA: water, trace research, visual surveys**	⊥	‡	⊥
Axis axis (Erxleben, 1777)	axis deer	terrestrial	absent	**camera traps, opportunistic observations, visual surveys**	◦	◦	◦	◦, †	◦, †
Corvus splendens Vieillot, 1817	house crow	terrestrial	absent	**acoustic surveys, camera traps, electrofishing, visual surveys**	◦	◦	◦	◦, †	◦, †, ‡
Herpestes javanicus (É.Geoffroy Saint-Hilaire, 1818)	Indian mongoose	terrestrial	absent	**camera traps, citizen science, eDNA: air, eDNA: soil, eDNA: water, traffic casualty collection**	◦	◦	◦	◦, †	◦, †, ‡
Procambarus clarkii (Girard, 1852)	red swamp crayfish	freshwater, brackishwater	established to limited extend	◦	**crayfish traps, eDNA: water, electrofishing, pheromone traps, visual surveys**	× , crayfish traps, eDNA: water, electrofishing, pheromone traps, visual surveys	⊥	†	†, ⊥

(continued)

Species	Vern name eng	Prius milieu	Invasion stage	Detection	Inventory	Distribution	Abundance	Distribution management	Abundance management
Xenopus laevis (Daudin, 1802)	African clawed frog	freshwater	established to limited extend	∘	#	**traps, eDNA: water, electrofishing, passive acoustic monitoring, pitfall traps, visual surveys**	**traps, eDNA: water, electrofishing, passive acoustic monitoring, pitfall traps, visual surveys**	‡	**traps, eDNA: water, electrofishing, passive acoustic monitoring, pitfall traps, visual surveys**
Myocastor coypus (Molina, 1782)	coypu	freshwater, terrestrial	established to limited extend	∘	#	**camera traps, eDNA: water, visual surveys**	⊥	**camera traps, eDNA: water, visual surveys**	‡, ⊥
Tamias sibiricus (Laxmann, 1769)	Siberian chipmunk	terrestrial	established to limited extend	∘	#	**camera traps, hair traps, visual surveys**	⊥	†	†, ‡, ⊥
Muntiacus reevesi (Ogilby, 1839)	Chinese muntjac	terrestrial	established to limited extend	∘	#	**camera traps, eDNA: air, passive acoustic monitoring, visual surveys**	**camera traps, eDNA: air, passive acoustic monitoring, visual surveys**	‡	**camera traps, eDNA: air, passive acoustic monitoring, visual surveys**
Cherax destructor Clark, 1936	Australian yabbi	freshwater	absent	×, $f*$, crayfish traps, eDNA: water, visual surveys	∘	∘	∘	∘, †, ‡	∘, †
Cherax quadricarinatus (von Martens, 1868)	Australian redclaw crayfish	freshwater	absent	×, $f*$, crayfish traps, eDNA: water, visual surveys	∘	∘	∘	∘, †, ‡	∘, †
Faxonius immunis (Hagen, 1870)	calico crayfish	freshwater	absent	×, crayfish traps, eDNA: water, visual surveys	∘	∘	∘	∘, †, ‡	∘, †
Channa argus (Cantor, 1842)	amur snakehead	freshwater	absent	△, ×, eDNA: water, electrofishing, trap fishery	∘	∘	∘, ⊥	∘, †, ‡	∘, †, ⊥
Misgurnus anguillicaudatus (Cantor, 1842)	amur mud loach	freshwater	absent	×, traps, eDNA: water, electrofishing	∘	∘	∘	∘, †, ‡	∘, †
Faxonius rusticus (Girard, 1852)	rusty crayfish	freshwater	absent	×, crayfish traps, eDNA: water, shooting traps	∘	∘	∘	∘, †	∘, †
Limnoperna fortunei (Dunker, 1857)	golden mussel	freshwater	absent	△, ∗∗, eDNA: water, visual surveys	∘	∘	∘	∘, †	∘, †

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Species	Vern name eng	Prius milieu	Invasion stage	Detection	Inventory	Distribution	Abundance	Distribution management	Abundance management
Misgurnus mohoity (Dybowski, 1869)	amur weatherfish	freshwater	absent	×, ∗∗, traps, eDNA: water, electrofishing, gill nets, trawl nets	∘	∘	∘	∘, †, ‡	∘, †
Marisa cornuarietis (Linnaeus, 1758)	Colombian ramshorn apple snail	freshwater	absent	×, ∗∗, eDNA: water, visual surveys	∘	∘	∘, ⊥	∘, †	∘, †, ⊥
Oxyura jamaicensis (J.F.Gmelin, 1789)	ruddy duck	freshwater	sporadically present	△, ×, visual surveys	∘	∘	∘	∘, ‡	∘
Pacifastacus leniusculus (Dana, 1852)	signal crayfish	freshwater	sporadically present	f∗, crayfish traps, eDNA: water	∘	∘	∘	∘, †, ‡	∘, †
Procambarus virginalis Lyko, 2017	marbled crayfish	freshwater	sporadically present	×, crayfish traps, eDNA: water, electrofishing, pheromone traps, visual surveys	∘	∘	∘, ⊥	∘	∘, ‡, ⊥
Faxonius virilis (Hagen, 1870)	northern crayfish	freshwater	sporadically present	×, u∗, crayfish traps, eDNA: water, shooting traps	∘	∘	∘	∘, †, ‡	∘, †
Cipangopaludina chinensis (J.E.Gray, 1833)	black snail	freshwater	sporadically present	×, u∗, eDNA: water, visual surveys	∘	∘	∘, ⊥	∘, †	∘, †, ‡, ⊥
Gambusia holbrooki Girard, 1859	bore-drain fish	freshwater, brackishwater	absent	△, eDNA: water, electrofishing	∘	∘	∘	∘, †, ‡	∘, †
Gambusia affinis (Baird & Girard, 1853)	live-bearing tooth-carp	freshwater, brackishwater	absent	△, ×, eDNA: water, electrofishing	∘	∘	∘, ⊥	∘, †, ‡	∘, †, ⊥
Morone americana (Gmelin, 1789)	Maryland bass hybrid	freshwater, brackishwater, marine	absent	×, traps, eDNA: water, electrofishing, gill nets, trawl nets	∘	∘	∘	∘, †	∘, †, ‡
Fundulus heteroclitus (Linnaeus, 1766)	killifish	freshwater, brackishwater, marine	absent	×, ∗∗, traps, eDNA: water, electrofishing, gill nets, trawl nets	∘	∘	∘	∘, †, ‡	∘, †
Mustela vison Schreber, 1777	American mink	freshwater, terrestrial	sporadically present	∗∗, camera traps, eDNA: water, trace research, visual surveys	∘	∘	∘, ⊥	∘	∘, ‡, ⊥
Branta canadensis (Linnaeus, 1758)	Canada goose	freshwater, terrestrial	widespread	△, visual surveys	∘	△, visual surveys	△, visual surveys	‡	△, visual surveys

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(continued)

Species	Vern name eng	Prius milieu	Invasion stage	Detection	Inventory	Distribution	Abundance	Distribution management	Abundance management
Acridotheres cristatellus (Linnaeus, 1758)	Chinese jungle mynah	terrestrial	absent	$f*$, acoustic surveys, passive acoustic monitoring, visual surveys	◦	◦	◦	◦, †	◦, †, ‡
Vespa mandarinia Smith, 1852	Asian giant hornet	terrestrial	absent	△ , citizen science, visual surveys	◦	◦	◦	◦, †, ‡	◦, †
Acridotheres tristis (Linnaeus, 1766)	common myna	terrestrial	absent	$f*$, acoustic surveys, passive acoustic monitoring, visual surveys	◦	◦	◦	◦, †	◦, †, ‡
Castor canadensis Kuhl, 1820	American beaver	terrestrial	absent	$f*$, eDNA: water, expert research, genetic methods	◦	◦	◦	◦, †, ‡	◦, †
Pachycondyla chinensis (Emery, 1895)	Asian needle ant	terrestrial	absent	$f*$, other, pitfall traps, visual surveys	◦	◦	◦, ⊥	◦, †	◦, †, ⊥
Solenopsis richteri Forel, 1909	black imported fire ant	terrestrial	absent	$f*$, other, pitfall traps, visual surveys	◦	◦	◦, ⊥	◦, †, ‡	◦, †, ⊥
Wasmannia auropunctata (Roger, 1863)	little fire ant	terrestrial	absent	$f*$, expert research, genetic methods, visual surveys	◦	◦	◦, ⊥	◦, †	◦, †, ‡, ⊥
Pycnonotus cafer (Linnaeus, 1766)	red-vented bulbul	terrestrial	absent	△, × , acoustic surveys, camera traps, eDNA: air, visual surveys	◦	◦	◦	◦, †, ‡	◦, †
Pycnonotus jocosus (Linnaeus, 1758)	red-whiskered bulbul	terrestrial	absent	△, × , acoustic surveys, camera traps, visual surveys	◦	◦	◦	◦, †	◦, †, ‡
Callosciurus erythraeus (Pallas, 1779)	Pallas's squirrel	terrestrial	absent	$u*$, acoustic surveys, camera traps, eDNA: air, hair traps, passive acoustic monitoring, sound playback surveys, visual surveys	◦	◦	◦, ⊥	◦, †, ‡	◦, †, ⊥

(continued)

Species	Vern name eng	Prius milieu	Invasion stage	Detection	Inventory	Distribution	Abundance	Distribution management	Abundance management
Nasua nasua (Linnaeus, 1766)	brown-nosed coati	terrestrial	absent	∗∗ , camera traps	◦	◦	◦	◦, †, ‡	◦, †
Platydemus manokwari Beauchamp, 1962	New Guinea flatworm	terrestrial	absent	∗∗ , visual surveys	◦	◦	◦, ⊥	◦, †	◦, †, ‡, ⊥
Arthurdendyus triangulatus (Dendy, 1895)	New Zealand flatworm	terrestrial	absent	$u*$, pitfall traps, shelter traps, tracker dogs, visual surveys	◦	◦	◦	◦, †, ‡	◦, †
Solenopsis geminata (Fabricius, 1804)	fire ant	terrestrial	absent	× , expert research, genetic methods, visual surveys	◦	◦	◦, ⊥	◦, †	◦, †, ‡, ⊥
Solenopsis invicta Buren, 1972	red imported fire ant	terrestrial	absent	×, $u*$, expert research, genetic methods, visual surveys	◦	◦	◦, ⊥	◦, †	◦, †, ‡, ⊥
Lampropeltis getula (Linnaeus, 1766)	common kingsnake	terrestrial	absent	∗∗ , pheromone traps, pitfall traps, visual surveys, NA	◦	◦	◦	◦, †	◦, †
Callosciurus finlaysonii (Horsfield, 1823)	Finlayson's squirrel	terrestrial	absent	×, $u*$, hair traps, visual surveys	◦	◦	◦	◦	◦, ‡
Myiopsitta monachus (Boddaert, 1783)	monk parakeet	terrestrial	sporadically present	△, × , acoustic surveys, camera traps, visual surveys	◦	◦	◦	◦, †	◦, †, ‡
Nyctereutes procyonoides (Gray, 1834)	Asiatic raccoon	terrestrial	sporadically present	×, $u*$, camera traps, visual surveys	◦	◦	◦	◦	◦, ‡
Bipalium kewense Moseley, 1878	hammerhead flatworm	terrestrial	sporadically present	×, $u*$, pitfall traps, shelter traps, tracker dogs, visual surveys	◦	◦	◦	◦, †, ‡	◦, †
Vespa velutina nigrithorax Buysson, 1905	Asian hornet	terrestrial	widespread	△ , traps, citizen science, visual surveys	◦	△ , traps, citizen science, visual surveys	△ , traps, citizen science, visual surveys	‡	△ , traps, citizen science, visual surveys
Alopochen aegyptiaca (Linnaeus, 1766)	Egyptian goose	terrestrial, freshwater, brackishwater	widespread	△ , visual surveys	◦	△ , visual surveys	△ , visual surveys	‡	△ , visual surveys
Asterias amurensis Lutken, 1871	flat-bottomed star	marine	absent	$f*$, eDNA: water	◦	◦	◦, ⊥	◦, †, ‡	◦, †, ⊥
Plotosus lineatus (Thunberg, 1787)	barbel-eel catfish	brackishwater, marine	absent	×, ∗∗ , eDNA: water	◦	◦	◦, ⊥	◦, †	◦, †, ⊥

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Species	Vern name eng	Prius milieu	Invasion stage	Detection	Inventory	Distribution	Abundance	Distribution management	Abundance management
Aedes albopictus (Skuse, 1894)	Asian tiger mosquito	terrestrial	established to limited extend	◦	$u*$, adult traps, eDNA: water, egg traps, pheromone traps, visual surveys	$\times$, $u*$, adult traps, eDNA: water, egg traps, pheromone traps, visual surveys	$\perp$	‡	$\perp$
Callinectes sapidus Rathbun, 1896	American blue crab		established to limited extend	◦	$**$, eDNA: water, other	$\times$, $**$, eDNA: water, other	$\times$, $**$, eDNA: water, other	†, ‡	†
Faxonius limosus (Rafinesque, 1817)	spiny-cheek crayfish	freshwater	widespread	◦	◦	$f*$, crayfish traps, eDNA: water, electrofishing, pheromone traps, visual surveys	$\perp$	†, ‡	†, $\perp$
Trachemys scripta (Thunberg In Schoepff, 1792)	common slider	freshwater	widespread	◦	◦	$\triangle$, $**$, traps, eDNA: water, visual surveys	$\triangle$, $**$, traps, eDNA: water, visual surveys	‡	$\triangle$, $**$, traps, eDNA: water, visual surveys
Lepomis gibbosus (Linnaeus, 1758)	common sunfish	freshwater, brackishwater	widespread	◦	◦	$\triangle$, $f*$, eDNA: soil, eDNA: water, electrofishing, trap fishery	$\perp$	†, ‡	†, $\perp$
Eriocheir sinensis H.Milne Edwards, 1853	Chinese mitten crab	freshwater, brackishwater, marine	widespread	◦	◦	$u*$, crab traps, eDNA: water, shooting traps	$u*$, crab traps, eDNA: water, shooting traps	‡	$u*$, crab traps, eDNA: water, shooting traps
Lithobates catesbeianus (Shaw, 1802)	American bull frog	freshwater, terrestrial	established to limited extend	◦	#	$\triangle$, eDNA: water	$\triangle$, eDNA: water	‡	$\triangle$, eDNA: water
Procyon lotor (Linnaeus, 1758)	common raccoon	terrestrial	established to limited extend	◦	#	$u*$, camera traps, visual surveys	$u*$, camera traps, visual surveys	$u*$, camera traps, visual surveys	$u*$, camera traps, visual surveys
Obama nungara Carbayo, Alvarez-Presas, Jones & Riutort, 2016	Obama flatworm	terrestrial	widespread	◦	◦	$**$, eDNA: soil, visual surveys	$\perp$	†	†, $\perp$
Mulinia lateralis (Say, 1822)	dwarf surfclam	marine	widespread	◦	◦	$f*$, eDNA: soil, soil samples, visual surveys	$f*$, eDNA: soil, soil samples, visual surveys	†	†

◦ scope not relevant due to invasion stage
\# scope not relevant as distribution area is known
† scope not relevant as species is not managed
‡ scope not relevant as information not necessary to evaluate management
$\perp$ scope not relevant as method to measure abundance is not available
$\triangle$ scope low priority as opportunistic observations are considered representative
$\times$ scope low priority as monitoring area is not known
$**$ scope low priority as both feasibility and urgency scores are smaller than cutoff
$u*$ scope low priority as urgency score is larger but feasibility score is smaller than cutoff
$f*$ scope low priority as feasibility score is larger but urgency score is smaller than cutoff

We see that for about 21% (8 out of 39) of all plants and about 18% (12 out of 66) of all animals at least one monitoring scope is retained as having high relevance and high priority. The respective plants are in alphabetical order:

- *Ailanthus altissima (Mill.) Swingle [EN: China-sumac, NL: hemelboom]*
- *Crassula helmsii (Kirk) Cockayne [EN: Australian swamp stonecrop, NL: watercrassula]*
- *Lagarosiphon major (Ridl.) Moss [EN: African elodea, NL: verspreidbladige waterpest]*
- *Ludwigia grandiflora (Michx.) Greuter & Burdet [EN: large-flower primrose-willow, NL: waterteunisbloem]*
- *Ludwigia peploides (Kunth) P.H.Raven [EN: floating primrose-willow, NL: kleine waterteunisbloem]*
- *Lygodium japonicum (Thunb.) Sw. [EN: Japanese climbing fern, NL: Japanse klimvaren]*
- *Lysichiton americanus Hultén & H.St.John [EN: American skunk-cabbage, NL: moerasaronskelk]*
- *Myriophyllum aquaticum (Vell.) Verdc. [EN: Brazilian water-milfoil, NL: parelvederkruid]*

The respective animals are in alphabetical order:

- *Ameiurus melas (Rafinesque, 1820) [EN: black bullhead, NL: zwarte Amerikaanse dwergmeerval]*
- *Axis axis (Erxleben, 1777) [EN: axis deer, NL: axishert]*
- *Corvus splendens Vieillot, 1817 [EN: house crow, NL: huiskraai]*
- *Herpestes javanicus (É.Geoffroy Saint-Hilaire, 1818) [EN: Indian mongoose, NL: Indische mangoeste]*
- *Muntiacus reevesi (Ogilby, 1839) [EN: Chinese muntjac, NL: Chinese muntjak]*
- *Myocastor coypus (Molina, 1782) [EN: coypu, NL: beverrat]*
- *Ondatra zibethicus (Linnaeus, 1766) [EN: muskrat, NL: muskusrat]*
- *Perccottus glenii Dybowski, 1877 [EN: amur sleeper, NL: amurgrondel]*
- *Procambarus clarkii (Girard, 1852) [EN: red swamp crayfish, NL: rode Amerikaanse rivierkreeft]*
- *Pseudorasbora parva (Temminck & Schlegel, 1846) [EN: false razbora, NL: blauwband]*
- *Tamias sibiricus (Laxmann, 1769) [EN: Siberian chipmunk, NL: Aziatische grondeekhoorn]*
- *Xenopus laevis (Daudin, 1802) [EN: African clawed frog, NL: Afrikaanse klauwkikker]*

For the species-scope combination not retained after prioritisation, the exact exclusion reasons can be revisited in Table 4.1 and Table 4.2, respectively. We provide a brief summary here. Looking at the plants first, there were 234 potential species-scope combinations in total. During Stage 1 of the prioritisation process 171 of these were excluded due to the following reasons (note that multiple exclusion criteria can apply per species-scope combination):

- invasion stage (147 times)
- species is not managed (64 times)
- information not necessary to evaluate management (31 times)
- distribution area is known (5 times)
- method to measure abundance is not available (4 times)

After Stage 1, 63 species-scope combinations were retained. During Stage 2, 55 exclusions happened due to the following reasons:

- monitoring area is not known (21 times)
- opportunistic observations are considered representative (21 times)
- both feasibility and urgency scores are smaller than cutoff (19 times)
- feasibility score is larger but urgency score is smaller than cutoff (9 times)
- urgency score is larger but feasibility score is smaller than cutoff (6 times)

Turning to the animals, there were 396 potential species-scope combinations to begin with. During Stage 1 of the prioritisation process, 299 combinations were excluded due to the following reasons:

- invasion stage (256 times)
- species is not managed (96 times)

- information not necessary to evaluate management (55 times)
- method to measure abundance is not available (46 times)
- distribution area is known (6 times)

After Stage 1, 97 species-scope combinations were retained, and the following reasons applied to the 85 exclusions during Stage 2:

- monitoring area is not known (28 times)
- opportunistic observations are considered representative (28 times)
- urgency score is larger but feasibility score is smaller than cutoff (17 times)
- both feasibility and urgency scores are smaller than cutoff (16 times)
- feasibility score is larger but urgency score is smaller than cutoff (14 times)

4.2.2 Focus scenarios for species subgroups

The prioritisation process enabled the identification of species–scope combinations that are both of high relevance and of high priority for structured monitoring in Flanders. This selection represents a meaningful advance: it narrows the field of candidate monitoring schemes and comprises those with the strongest justification for further planning.

Yet despite this filtering, the number of retained combinations remains large and additional focus is therefore helpful. To this end, we complement the presentation of the prioritisation results in the previous section with three strategic scenarios. Each scenario reflects a different policy or practical rationale for selecting a different subset of the prioritised combinations of species and monitoring scopes:

- **Scenario 1** focuses on prioritised species that are additionally flagged by ANB as management priorities (based on previous scientific work by INBO). This implies an emphasis on the monitoring scopes related to the evaluation of eradication, population control or containment measures (i.e. distribution and abundance under management). These species are of particular operational interest and align with ongoing or anticipated interventions.
- **Scenario 2** highlights prioritised species for which early detection is key (i.e., scope detection is retained). This includes species not yet present in Flanders or only sporadically recorded, as well as widespread species that remain absent from high-value conservation areas. Early detection in these contexts supports timely and cost-effective responses, in line with the Invasive Alien Species Regulation and broader prevention goals.
- **Scenario 3** targets prioritised species for which distribution monitoring is most relevant. This includes both species established to a limited extent and those already widespread. This scenario focuses on national and EU reporting obligations under the Invasive Alien Species Regulation.

These three scenarios provide complementary perspectives on how to further narrow the focus for developing monitoring schemes. They reflect a balance between operational needs, early-intervention opportunities, and legal obligations. In the following we present each scenario and explore method-based synergies that may support coordinated planning of monitoring schemes. Tables providing a simultaneous overview over all species the survey provides data on are included in Section A.1.

4.2.2.1 Scenario 1: ANB focus species

To define Scenario 1, we start from the list of species identified by ANB as management priorities, based on previous scientific work by INBO. We then check which of these species passed our expert survey-based prioritisation. For about 40% of the ANB focus plants and about 22% of the ANB focus animals at least one monitoring scope was retained after Stage 2 of the prioritisation. The respective plants are in alphabetical order:

- *Crassula helmsii (Kirk) Cockayne [EN: Australian swamp stonecrop, NL: watercrassula]*
- *Lagarosiphon major (Ridl.) Moss [EN: African elodea, NL: verspreidbladige waterpest]*

- *Ludwigia grandiflora (Michx.) Greuter & Burdet [EN: large-flower primrose-willow, NL: waterteunis-bloem]*
- *Ludwigia peploides (Kunth) P.H.Raven [EN: floating primrose-willow, NL: kleine waterteunisbloem]*
- *Lysichiton americanus Hultén & H.St.John [EN: American skunk-cabbage, NL: moerasaronskelk]*
- *Myriophyllum aquaticum (Vell.) Verdc. [EN: Brazilian water-milfoil, NL: parelvederkruid]*

The respective animals are in alphabetical order:

- *Muntiacus reevesi (Ogilby, 1839) [EN: Chinese muntjac, NL: Chinese muntjak]*
- *Myocastor coypus (Molina, 1782) [EN: coypu, NL: beverrat]*
- *Ondatra zibethicus (Linnaeus, 1766) [EN: muskrat, NL: muskusrat]*
- *Procambarus clarkii (Girard, 1852) [EN: red swamp crayfish, NL: rode Amerikaanse rivierkreeft]*
- *Tamias sibiricus (Laxmann, 1769) [EN: Siberian chipmunk, NL: Aziatische grondeekhoorn]*
- *Xenopus laevis (Daudin, 1802) [EN: African clawed frog, NL: Afrikaanse klauwkikker]*

Not retained here, but still prioritised by ANB are, among the plants:

- *Alternanthera philoxeroides (Mart.) Griseb. [EN: alligator weed, NL: alligatorkruid]*
- *Elodea nuttallii (Planch.) H.St.John [EN: nutall waterweed, NL: smalle waterpest]*
- *Koenigia polystachya (Wall. ex Meisn.) T.M.Schust. & Reveal [EN: Himalayan knotweed, NL: Afghaanse duizendknoop]*
- *Myriophyllum heterophyllum Michx. [EN: broadleaf water-milfoil, NL: ongelijbladig vederkruid]*
- *Persicaria perfoliata (L.) H.Gross [EN: Asian tearthumb, NL: gestekelde duizendknoop]*
- *Pontederia crassipes Mart. [EN: water-hyacinth, NL: waterhyacint]*
- *Reynoutria japonica Houtt., Reynoutria sachalinensis (F.Schmidt) Nakai, Reynoutria ×bohemica Chrtek & Chrtková [EN: Asian, giant, Bohemian knotweed, NL: Japanse, Sachalinse, Boheemse duizendknoop]*
- *Rugulopteryx okamurae (E.Y.Dawson) I.K.Hwang, W.J.Lee & H.S.Kim, 2009 [EN: algae stomp, NL: gaffelwier]*
- *Salvinia ×molesta D.S.Mitch. [EN: African payal, NL: grote vlotvaren]*

Among the animals these are:

- *Aedes albopictus (Skuse, 1894) [EN: Asian tiger mosquito, NL: Aziatische tijgermug]*
- *Alopochen aegyptiaca (Linnaeus, 1766) [EN: Egyptian goose, NL: nijlgans]*
- *Branta canadensis (Linnaeus, 1758) [EN: Canada goose, NL: Canadese gans]*
- *Callosciurus erythraeus (Pallas, 1779) [EN: Pallas’s squirrel, NL: Pallas’ eekhoorn]*
- *Callosciurus finlaysonii (Horsfield, 1823) [EN: Finlayson’s squirrel, NL: Thaise eekhoorn]*
- *Cherax quadricarinatus (von Martens, 1868) [EN: Australian redclaw crayfish, NL: Australische rood-klauwkreeft]*
- *Cipangopaludina chinensis (J.E.Gray, 1833) [EN: black snail, NL: Chinese moerasslak]*
- *Faxonius immunis (Hagen, 1870) [EN: calico crayfish, NL: calicotrivierkreeft]*
- *Faxonius limosus (Rafinesque, 1817) [EN: spiny-cheek crayfish, NL: gevlekte rivierkreeft]*
- *Faxonius rusticus (Girard, 1852) [EN: rusty crayfish, NL: roestbruine Amerikaanse rivierkreeft]*
- *Faxonius virilis (Hagen, 1870) [EN: northern crayfish, NL: geknobbelde Amerikaanse rivierkreeft]*
- *Lithobates catesbeianus (Shaw, 1802) [EN: American bull frog, NL: Amerikaanse stierkikker]*
- *Misgurnus mohoity (Dybowski, 1869) [EN: amur weatherfish, NL: Noord-Aziatische modderkruiper]*
- *Mustela vison Schreber, 1777 [EN: American mink, NL: Amerikaanse nerts]*
- *Oxyura jamaicensis (J.F.Gmelin, 1789) [EN: ruddy duck, NL: rosse stekelstaart]*
- *Pacifastacus leniusculus (Dana, 1852) [EN: signal crayfish, NL: Californische rivierkreeft]*
- *Procambarus virginalis Lyko, 2017 [EN: marbled crayfish, NL: marmerkreeft]*
- *Procyon lotor (Linnaeus, 1758) [EN: common raccoon, NL: wasbeer]*
- *Trachemys scripta (Thunberg In Schoepff, 1792) [EN: common slider, NL: lettersierschildpad]*
- *Vespa velutina nigrithorax Buysson, 1905 [EN: Asian hornet, NL: Aziatische hoornaar]*

See again tables Table 4.1 and Table 4.2 for the exact exclusion reasons.

For the subset of ANB focus species with at least one high-relevance, high-priority monitoring scope, there was a management-related scope among the retained scopes in more than half of the cases. For the remaining cases, the management-related scopes had been excluded due to the species not being managed, or due to distribution or abundance information not being necessary to evaluate management, or due to the lack of a method to measure abundance. Given the focus on management-related monitoring scopes in this scenario, the latter subset of species is not further examined in the following. This concerns the species *American skunk-cabbage Siberian chipmunk*, *American skunk-cabbage muskrat*, *American skunk-cabbage red swamp crayfish*.

We inspect the method-based synergies under the management-related monitoring scopes. To this end, Table 4.3, Table 4.4, and Table 4.5 show the monitoring methods shared among the ANB focus plants and animals for the scopes distribution under management and abundance under management. The tables are structured such that primary, secondary and tertiary species (see Section 3.3.3.2) are presented in groups of rows. Reported monitoring methods are arranged in columns and table cells are filled with colour when a method was reported for a species. Within species groups, rows are sorted by milieu according to the order: freshwater, freshwater, brackishwater, freshwater, brackishwater, marine, freshwater, terrestrial, terrestrial, terrestrial, brackishwater, terrestrial, freshwater, brackishwater, marine, marine, brackisch, freshwater, brackishwater, marine.

Among the ANB focus plants, a clear synergy emerges for the **scope abundance under management** (Table 4.3): five (partly) freshwater species (*African elodea*, *Australian swamp stonecrop*, *Brazilian watermilfoil*, *floating primrose-willow*, *large-flower primrose-willow*) can be monitored using visual surveys, with four also suitable for aquatic environmental DNA (eDNA). All are primary species, making them strong candidates for a shared monitoring approach.

Table 4.3: Method-based synergies for Scenario 1 plants under scope abundance after management

					Method	
Species	Vern name eng	Invasion stage	Taxon	Prius milieu	Visual surveys	EDNA: water
Primary species						
Lagarosiphon major (Ridl.) Moss	African elodea	established to limited extend	plant	freshwater	■	■
Ludwigia peploides (Kunth) P.H.Raven	floating primrose-willow	established to limited extend	plant	freshwater	■	■
Ludwigia grandiflora (Michx.) Greuter & Burdet	large-flower primrose-willow	widespread	plant	freshwater	■	■
Myriophyllum aquaticum (Vell.) Verdc.	Brazilian water-milfoil	widespread	plant	freshwater	■	
Crassula helmsii (Kirk) Cockayne	Australian swamp stonecrop	widespread	plant	freshwater, terrestrial	■	■

For the ANB-priority animals, scope **distribution under management** reveals a potential synergy between the *coypu* and the *common raccoon*, which can both be monitored using camera traps and visual surveys (Table 4.4).

For the scope **abundance under management**, two limited method-based synergies emerge (Table 4.5), both involving the *Chinese muntjac*. One groups it with the *common raccoon*, based on shared use of visual surveys and camera traps; the other links it with the *African clawed frog*, based on visual surveys and passive acoustic monitoring.

Table 4.4: Method-based synergies for Scenario 1 animals under scope distribution after management

Species	Vern name eng	Invasion stage	Taxon	Prius milieu	Method: Camera traps	Method: EDNA: water	Method: Visual surveys
Primary species							
Myocastor coypus (Molina, 1782)	coypu	established to limited extend	mammal	freshwater, terrestrial	■	■	■
Tertiary species							
Procyon lotor (Linnaeus, 1758)	common raccoon	established to limited extend	mammal	terrestrial	■		■

Table 4.5: Method-based synergies for Scenario 1 animals under scope abundance after management

Species	Vern name eng	Invasion stage	Taxon	Prius milieu	Method: Visual surveys	Method: Passive acoustic monitoring	Method: Camera traps	Method: EDNA: water	Method: Electrofishing	Method: Traps	Method: Pitfall traps	Method: EDNA: air
Primary species												
Xenopus laevis (Daudin, 1802)	African clawed frog	established to limited extend	amphibian	freshwater	■	■		■	■	■	■	
Muntiacus reevesi (Ogilby, 1839)	Chinese muntjac	established to limited extend	mammal	terrestrial	■	■	■					■
Tertiary species												
Procyon lotor (Linnaeus, 1758)	common raccoon	established to limited extend	mammal	terrestrial	■		■					

4.2.2.2 Scenario 2: Focus on monitoring scope detection

The focus on detection under this second scenario is motivated by the acknowledged importance and effectiveness of early detection and intervention in combating biological invasions. Here we thus consider all species for which the monitoring scope detection has high relevance and high priority according to our survey-based approach. The respective plants are in alphabetical order:

- *Ailanthus altissima (Mill.) Swingle [EN: China-sumac, NL: hemelboom]*
- *Lygodium japonicum (Thunb.) Sw. [EN: Japanese climbing fern, NL: Japanse klimvaren]*
- *Lysichiton americanus Hultén & H.St.John [EN: American skunk-cabbage, NL: moerasaronskelk]*

The respective animals are in alphabetical order:

- *Ameiurus melas (Rafinesque, 1820) [EN: black bullhead, NL: zwarte Amerikaanse dwergmeerval]*
- *Axis axis (Erxleben, 1777) [EN: axis deer, NL: axishert]*
- *Corvus splendens Vieillot, 1817 [EN: house crow, NL: huiskraai]*
- *Herpestes javanicus (É.Geoffroy Saint-Hilaire, 1818) [EN: Indian mongoose, NL: Indische mangoeste]*
- *Ondatra zibethicus (Linnaeus, 1766) [EN: muskrat, NL: muskusrat]*
- *Perccottus glenii Dybowski, 1877 [EN: amur sleeper, NL: amurgrondel]*
- *Pseudorasbora parva (Temminck & Schlegel, 1846) [EN: false razbora, NL: blauwband]*

Table 4.6 and Table 4.7 show the method-based synergies for these plants and animals under scope detection. The tables are structured as under Scenario 1. For plants (see Table 4.6) we find that visual surveys are recommended for a group of six species, all at least partly terrestrial, consisting of three primary species (*American skunk-cabbage*, *China-sumac*, *Japanese climbing fern*) and three secondary species (*Chinese packing grass*, *Chinese tallow*, *crimson fountaingrass*). Among these, three species are currently absent in Flanders, two are sporadically present, and one is already widespread. All occur in terrestrial habitats, with American skunk-cabbage also associated with freshwater environments.

Table 4.6: Method-based synergies for Scenario 2 plants under scope detection

Species	Vern name eng	Invasion stage	Taxon	Prius milieu	Method: Visual surveys
Primary species					
Lysichiton americanus Hultén & H.St.John	American skunk-cabbage	sporadically present	plant	freshwater, terrestrial	
Lygodium japonicum (Thunb.) Sw.	Japanese climbing fern	absent	plant	terrestrial	
Ailanthus altissima (Mill.) Swingle	China-sumac	widespread	plant	terrestrial	
Secondary species					
Triadica sebifera (L.) Small	Chinese tallow	absent	plant	terrestrial	
Microstegium vimineum (Trin.) A.Camus	Chinese packing grass	absent	plant	terrestrial	
Cenchrus setaceus (Forssk.) Morrone	crimson fountain-grass	sporadically present	plant	terrestrial	

Turning to the animals, two larger groups arise (see Table 4.7): The first, aquatic group encompasses three fish species (*amur sleeper*, *black bullhead*, *false razbora*) and the *muskrat* as primary species as well as the *signal crayfish* and the *flat-bottomed star* as secondary species. Aquatic eDNA qualifies as a group-wide monitoring method suited for detection. Electric fishing, trapping and netting can in addition be used for the subgroup of fish.

The second group comprises a number of primary (*Indian mongoose*, *axis deer*, *house crow*, *muskrat*), secondary (*Asian needle ant*, *Chinese jungle mynah*, *black imported fire ant*, *common myna*, *little fire ant*) and tertiary (*New Zealand flatworm*, *Pallas's squirrel*) terrestrial species. For this large group synergies arise in terms of the potential use of visual surveys, camera traps for the subgroup of mammals, and acoustic surveys for the subgroup of birds.

4.2.2.3 Scenario 3: Focus on monitoring scope distribution

The third scenario focuses on the monitoring scope distribution motivated by the clear requirement of the Invasive Alien Species Regulation to report on the distribution of IAS (see Section 2.3). We thus consider all species for which the monitoring scope distribution gets assigned a high relevance and high priority in the survey-based prioritisation. The respective plants are in alphabetical order:

- *Ailanthus altissima (Mill.) Swingle [EN: China-sumac, NL: hemelboom]*
- *Crassula helmsii (Kirk) Cockayne [EN: Australian swamp stonecrop, NL: watercrassula]*
- *Lagarosiphon major (Ridl.) Moss [EN: African elodea, NL: verspreidbladige waterpest]*
- *Ludwigia grandiflora (Michx.) Greuter & Burdet [EN: large-flower primrose-willow, NL: waterteunisbloem]*

Table 4.7: Method-based synergies for Scenario 2 animals under scope detection

Species	Vern name eng	Invasion stage	Taxon	Prius milieu	EDNA: water	Electrofishing	Camera traps	Visual surveys	Traps	Gill nets	Trawl nets	Trace research	Opportunistic observations	Acoustic surveys	Citizen science	EDNA: air	EDNA: soil	Traffic casualty collection
Primary species																		
Ameiurus melas (Rafinesque, 1820)	black bullhead	sporadically present	fish	freshwater	■	■												
Perccottus glenii Dybowski, 1877	amur sleeper	absent	fish	freshwater, brackishwater	■	■			■	■	■							
Pseudorasbora parva (Temminck & Schlegel, 1846)	false razbora	widespread	fish	freshwater, brackishwater	■	■			■	■	■							
Ondatra zibethicus (Linnaeus, 1766)	muskrat	widespread	mammal	freshwater, terrestrial	■		■	■				■						
Herpestes javanicus (É.Geoffroy Saint-Hilaire, 1818)	Indian mongoose	absent	mammal	terrestrial	■		■								■	■	■	■
Corvus splendens Vieillot, 1817	house crow	absent	bird	terrestrial		■	■	■						■				
Axis axis (Erxleben, 1777)	axis deer	absent	mammal	terrestrial			■	■					■					
Secondary species																		
Pacifastacus leniusculus (Dana, 1852)	signal crayfish	sporadically present	crustacean	freshwater	■													
Acridotheres cristatellus (Linnaeus, 1758)	Chinese jungle mynah	absent	bird	terrestrial				■						■				
Acridotheres tristis (Linnaeus, 1766)	common myna	absent	bird	terrestrial				■						■				
Pachycondyla chinensis (Emery, 1895)	Asian needle ant	absent	insect	terrestrial				■										
Solenopsis richteri Forel, 1909	black imported fire ant	absent	insect	terrestrial				■										
Wasmannia auropunctata (Roger, 1863)	little fire ant	absent	insect	terrestrial				■										
Castor canadensis Kuhl, 1820	American beaver	absent	mammal	terrestrial	■													
Asterias amurensis Lutken, 1871	flat-bottomed star	absent	echinoderm	marine	■													
Tertiary species																		
Callosciurus erythraeus (Pallas, 1779)	Pallas's squirrel	absent	mammal	terrestrial			■	■						■		■		
Arthurdendyus triangulatus (Dendy, 1895)	New Zealand flatworm	absent	flatworm	terrestrial				■										

- *Ludwigia peploides (Kunth) P.H.Raven [EN: floating primrose-willow, NL: kleine waterteunisbloem]*
- *Myriophyllum aquaticum (Vell.) Verdc. [EN: Brazilian water-milfoil, NL: parelvederkruid]*

The respective animals are in alphabetical order:

- *Muntiacus reevesi (Ogilby, 1839) [EN: Chinese muntjac, NL: Chinese muntjak]*
- *Myocastor coypus (Molina, 1782) [EN: coypu, NL: beverrat]*
- *Ondatra zibethicus (Linnaeus, 1766) [EN: muskrat, NL: muskusrat]*
- *Procambarus clarkii (Girard, 1852) [EN: red swamp crayfish, NL: rode Amerikaanse rivierkreeft]*
- *Pseudorasbora parva (Temminck & Schlegel, 1846) [EN: false razbora, NL: blauwband]*
- *Tamias sibiricus (Laxmann, 1769) [EN: Siberian chipmunk, NL: Aziatische grondeekhoorn]*
- *Xenopus laevis (Daudin, 1802) [EN: African clawed frog, NL: Afrikaanse klauwkikker]*

Note that there is substantial overlap between the species considered under this and the first scenario. In part, this is due to our choice of assigning relevance of the scenario-specific scopes based on largely overlapping invasion stages (see Section 3.3).

Table 4.8 and Table 4.9 show the method-based synergies for the above-listed plants and animals under scope distribution. The tables are again structured as under Scenario 1. For plants we find the same aquatic group as under Scenario 1 with the same method-based synergies, visual surveys and aquatic eDNA.

Table 4.8: Method-based synergies for Scenario 3 plants under scope distribution

					Method	
Species	Vern name eng	Invasion stage	Taxon	Prius milieu	Visual surveys	EDNA: water
Primary species						
Lagarosiphon major (Ridl.) Moss	African elodea	established to limited extend	plant	freshwater	x	x
Ludwigia peploides (Kunth) P.H.Raven	floating primrose-willow	established to limited extend	plant	freshwater	x	x
Ludwigia grandiflora (Michx.) Greuter & Burdet	large-flower primrose-willow	widespread	plant	freshwater	x	x
Myriophyllum aquaticum (Vell.) Verdc.	Brazilian water-milfoil	widespread	plant	freshwater	x	
Crassula helmsii (Kirk) Cockayne	Australian swamp stonecrop	widespread	plant	freshwater, terrestrial	x	x
Ailanthus altissima (Mill.) Swingle	China-sumac	widespread	plant	terrestrial	x	

For the animals, two groups emerge. A first, terrestrial group comprises two primary mammals (*Chinese muntjac*, *Siberian chipmunk*) and a tertiary mammal (*common raccoon*), all of which can be monitored using visual surveys and camera traps.

A second, aquatic group consists of four primary species (*African clawed frog*, *coypu*, *false razbora*, *muskrat*), a secondary crayfish (*spiny-cheek crayfish*) and a tertiary species (*Chinese mitten crab*), sharing aquatic eDNA as a monitoring method.

Note that for the majority of these animal species (i.e., *African clawed frog*, *Chinese muntjac*, *common raccoon*, *coypu*) similar method-based synergies were already found under Scenario 1.

Table 4.9: Method-based synergies for Scenario 3 animals under scope distribution

Species	Vern name eng	Invasion stage	Taxon	Prius milieu	Method: Visual surveys	EDNA: water	Camera traps	Traps	Electrofishing	Passive acoustic monitoring	Gill nets	Trawl nets	Trace research	Pitfall traps	Hair traps	EDNA: air
Primary species																
Xenopus laevis (Daudin, 1802)	African clawed frog	established to limited extend	amphibian	freshwater	■	■		■	■	■				■		
Pseudorasbora parva (Temminck & Schlegel, 1846)	false razbora	widespread	fish	freshwater, brackishwater		■		■	■		■	■				
Myocastor coypus (Molina, 1782)	coypu	established to limited extend	mammal	freshwater, terrestrial	■	■	■									
Ondatra zibethicus (Linnaeus, 1766)	muskrat	widespread	mammal	freshwater, terrestrial	■	■	■						■			
Tamias sibiricus (Laxmann, 1769)	Siberian chipmunk	established to limited extend	mammal	terrestrial	■		■								■	
Muntiacus reevesi (Ogilby, 1839)	Chinese muntjac	established to limited extend	mammal	terrestrial	■		■			■						■
Secondary species																
Faxonius limosus (Rafinesque, 1817)	spiny-cheek crayfish	widespread	crustacean	freshwater	■	■			■							
Mulinia lateralis (Say, 1822)	dwarf surfclam	widespread	mollusk	marine	■											
Tertiary species																
Eriocheir sinensis H.Milne Edwards, 1853	Chinese mitten crab	widespread	crustacean	freshwater, brackishwater, marine		■										
Procyon lotor (Linnaeus, 1758)	common raccoon	established to limited extend	mammal	terrestrial	■		■									

4.3 SOME CAVEATS

The design of the expert survey, the processing of the collected input and, by consequence, the survey results are shaped by a whole range of substantive and methodological choices. As the present analysis aimed to provide a first broad overview over IAS monitoring priorities in Flanders based on expert input, we aimed to apply a relatively simple approach. While alternatives exist for virtually all of the implemented choices, a few more concrete points of concern might arise.

A first concern might be that the current prioritisation exercise falls somewhat short when it comes to the potential monitoring of early eradication measures. Species for which such measures would be relevant are currently only considered under the monitoring scope detection and not under the management-related scopes, as we tied the latter to distribution or abundance monitoring, for which species needed to be at least limitedly established. Had we included the evaluation of early eradication measures either via an existing or an additional monitoring scope, then Scenario 1 - with its focus on management - could have been extended in principle. In practice, however, we would not have seen much change in the results, as 5 out of 6 plants and 16 out of 17 animals for which detection was deemed relevant were not retained after the second round of the survey-based prioritisation process. This is due to the relatively strict exclusion criteria employed in relation to the monitoring scope detection (see Section 3.3). These would likely also have applied had we considered the downstream monitoring scope of evaluating early eradication following detection.

Another potential concern with regard to the exclusion criteria used for scope detection is that the relevance of this scope was tied to particular invasion stages - specifically, species being absent, sporadically present, or widespread but absent from conservation areas. Species that are established to a limited extent were not included. This was a deliberate choice, as the generic nature of the current analysis did not allow for the incorporation of species-specific distribution data. Such data would be necessary to identify areas where detection monitoring might still be relevant for species already established to a limited extent elsewhere in the Flemish region. A more detailed, species-level analysis focusing on one or a few limitedly established IAS could, however, reveal such areas and justify inclusion of this category in future assessments.

Next, turning to the representativeness of opportunistic observations as an exclusion criterion, we should highlight the following inconsistency: while we have used it as a general criterion to assign low relevance to any monitoring scope, the original question only addressed representativeness with respect to a species' distribution. Future assessments of expert knowledge should consider the representativeness of opportunistic observations in a more differentiated manner. For the current results, we note that the representativeness of opportunistic observations is rarely the sole reason of exclusion, although there are a few cases (e.g., *American bull frog*, but see the following chapter).

Considering the approach of having different experts provide judgements about the status of different IAS in Flanders, one might be concerned about rater effects: differences that arise between species might in part reflect differences between experts and their judgements, rather than differences between species. Unfortunately, we can neither rule out such effects, nor quantify them, as we did not cross experts with species in our study design. Workload is of course a major consideration here, as experts are in high demand already. We, however, attempted to select experts to the best of our knowledge.

Finally, regarding the numerical processing of the collected expert input, we made certain choices that could have affected the survey results: response scores were treated as interval-scaled and summarized via arithmetic means across questions, critical values for expert rated-feasibility and urgency were based on the 50th percentile of the distribution of mean scores across all species. Alternatively, expert responses could be treated as ordinal - with consequences for further processing - or summarized in different ways; also, critical values can be determined in various manners. Our choices were mainly guided by simplicity and interpretability.

5 STEERING COMMITTEE MEETING AND DECISION

5.1 MEETING DETAILS AND AGENDA

The steering committee meeting was held on Wednesday, April 23, from 13:30 to 16:00 in Brussels. The meeting brought together key representatives from the involved institutions. Attending on behalf of INBO were Diederik Strubbe, Tim Adriaens, Janne Adolf and Thierry Onkelinx. Nicolas Pardon attended on behalf of ANB, while Dan Slootmakers represented VMM.

The meeting began with a brief round of introductions, during which each participant outlined their main areas of interest and institutional priorities related to IAS monitoring. This was followed by a structured presentation outlining the purpose and design of the expert survey and the logic and workflow underlying the proposed prioritisation of monitoring schemes. Results were presented in terms of the three scenarios detailed in Section 4.2.2. It was emphasized that the primary objective of the meeting was to enable the steering committee to decide which species or species groups should be prioritised for structured monitoring in Flanders. The results of the survey and prioritisation process were put forward as guiding but not binding.

After this overview the floor was opened for questions and discussion, and an optional review of the implementation details of the employed approach. The final phase of the meeting was then dedicated to decision-making.

5.2 SPECIES DECIDED UPON BY THE COMMITTEE

5.2.1 Initial feedback

The first feedback from the steering committee focused on the expert evaluation component of the survey framework. The expert input was acknowledged as highly valuable; however, it was noted that three potentially important species had not been evaluated (*Himalayan balsam*, *cartwheel-flower*, *floating pennywort*). This was due to a lack of expert input (see Section 4.1.1). The steering committee agreed that these three species are considered important and should ideally be included in the prioritisation. It was proposed to collect expert assessments for these species at a later stage, allowing their inclusion in future iterations of the prioritisation process.

A second discussion point concerned the choice between a species-oriented prioritisation versus an approach based on potential method-based synergies. The committee recognized the added value of identifying monitoring methods that could efficiently target multiple IAS simultaneously. Nevertheless, it was agreed that the current overview of synergies remains exploratory and lacks the resolution needed to inform decision making. Several examples were cited to illustrate this, such as cases where the same monitoring method (e.g., camera traps) might be applicable to both terrestrial and aquatic species in theory, but its implementation in practice would be very different due to habitat constraints. Such implementation differences would also undermine potential synergies during the planning phase. In light of these limitations, the committee decided to proceed with a species-oriented prioritisation. Once priority species have been identified, further assessment of method-based synergies – including those with lower-priority species – can be undertaken to increase planning and monitoring efficiency.

5.2.2 Compiling a consolidated species list

Following the decision to adopt a species-oriented approach, the steering committee reviewed the three proposed prioritisation scenarios. After discussion, it was concluded that Scenario 1 - focus on ANB priority species and management - and Scenario 3 - focus on distribution - most closely reflected the committee's priorities and were therefore preferred. Scenario 2, which emphasized early detection of new potential invaders, was considered less relevant to consider at this stage, although its rationale was acknowledged. It was also pointed out that detection is more realistically carried out via opportunistic data than via structured monitoring schemes if a balance of costs and benefits is to be maintained.

However, rather than selecting a single scenario, the committee opted to extract a number of species across scenarios to compile into a consolidated species list and select the monitoring scopes deemed most relevant for each species. The committee's species list consists of 13 species receiving a high-priority status in the survey-based prioritisation (i.e., at least one scope of high priority; *African clawed frog*, *African elodea*, *American skunk-cabbage*, *Australian swamp stonecrop*, *Brazilian water-milfoil*, *China-sumac*, *Chinese muntjac*, *amur sleeper*, *black bullhead*, *coypu*, *floating primrose-willow*, *large-flower primrose-willow*, *muskrat*), four species receiving a low-priority status (i.e., at least one scope relevant but not of high priority; *American bull frog*, *Asiatic raccoon*, *common raccoon*, *common slider*), and one with no survey data available (*floating pennywort*). Two species that were rated as having a high priority in the survey were explicitly excluded at this stage: the *Japanese climbing fern*, which is not yet present in Flanders and for which early detection was not considered a sufficient reason to warrant inclusion; and the *false razbora*, which, despite initial discussion on targeted exclusion from sensitive areas such as nature reserves, was deemed too widespread for a meaningful monitoring scheme of that nature. In addition, five other high-priority species were not further considered for the consolidated list (*Indian mongoose*, *Siberian chipmunk*, *axis deer*, *house crow*, *red swamp crayfish*). Table 5.1 lists all species retained in the consolidated list, including their survey scenario origin and the monitoring scopes identified as relevant in the survey.

5.2.3 Further refinement

To further refine the compiled list and identify the species for which the development of structured monitoring schemes is most urgent, the representatives from ANB and VMM were each asked to select five species from the consolidated list deemed most important to address first. The selection proceeded in alternating turns, allowing both representatives to contribute equally to the short-list. The remaining species - those not selected - are indicated in grey in Table 5.1 above.

The reasons for not selecting certain species at this stage varied. For example, the *China-sumac* was excluded due to ongoing debate about the species' invasiveness in protected nature areas. While it can be invasive in specific habitats such as dunes, it is not universally regarded as a harmful invader in all contexts, making it difficult to justify a general monitoring scheme within the scope of this exercise. Other species, such as the *black bullhead*, were acknowledged as important but currently and in the scope of this exercise deprioritised due to the availability of existing (project-based) monitoring efforts relying on eDNA. Its distribution is likely relatively well known and limited in extent. The hope is that species like this, although not prioritised in this step, will still be captured through broader aquatic monitoring schemes designed for aquatic invaders.

A third group of species, such as the *Australian swamp stonecrop*, was excluded primarily because of uncertainty regarding the feasibility and effectiveness of management interventions. In such cases, the absence of clear options for action limits the practical value of establishing monitoring schemes at this time.

5.2.4 Final selection of species for proof of concept monitoring design

In the final step of the present prioritisation exercise, the representatives of ANB and VMM were invited to further narrow down the short-list by selecting two species each from the remaining candidates. This was again done through an alternating selection process. At this stage, the focus was placed solely on identifying

Table 5.1: Consolidated species list as decided upon by the steering committee

Species	Vern name eng	Prius milieu	Invasion stage	Scenarios	Relevant monitoring scopes
plant					
Ailanthus altissima (Mill.) Swingle	China-sumac	terrestrial	widespread	Scenario 1, Scenario 2, Scenario 3	distribution under management, abundance, distribution, detection
Lagarosiphon major (Ridl.) Moss	African elodea	freshwater	established to limited extend	Scenario 1, Scenario 3	abundance under management, abundance, distribution
Ludwigia peploides (Kunth) P.H.Raven	floating primrose-willow	freshwater	established to limited extend	Scenario 1, Scenario 3	abundance under management, abundance, distribution
Ludwigia grandiflora (Michx.) Greuter & Burdet	large-flower primrose-willow	freshwater	widespread	Scenario 1, Scenario 3	abundance under management, abundance, distribution
Myriophyllum aquaticum (Vell.) Verdc.	Brazilian water-milfoil	freshwater	widespread	Scenario 1, Scenario 3	abundance under management, abundance, distribution
Crassula helmsii (Kirk) Cockayne	Australian swamp stonecrop	freshwater, terrestrial	widespread	Scenario 1, Scenario 3	abundance under management, abundance, distribution
Lysichiton americanus Hultén & H.St.John	American skunk-cabbage	freshwater, terrestrial	sporadically present	Scenario 2	detection
Hydrocotyle ranunculoides L.fil.	floating pennywort	freshwater			
animal					
Xenopus laevis (Daudin, 1802)	African clawed frog	freshwater	established to limited extend	Scenario 1, Scenario 3	abundance under management, abundance, distribution
Myocastor coypus (Molina, 1782)	coypu	freshwater, terrestrial	established to limited extend	Scenario 1, Scenario 3	distribution under management, distribution
Muntiacus reevesi (Ogilby, 1839)	Chinese muntjac	terrestrial	established to limited extend	Scenario 1, Scenario 3	abundance under management, abundance, distribution
Procyon lotor (Linnaeus, 1758)	common raccoon	terrestrial	established to limited extend	Scenario 1, Scenario 3	abundance under management, distribution under management, abundance, distribution
Ondatra zibethicus (Linnaeus, 1766)	muskrat	freshwater, terrestrial	widespread	Scenario 2, Scenario 3	distribution, detection
Ameiurus melas (Rafinesque, 1820)	black bullhead	freshwater	sporadically present	Scenario 2	detection
Perccottus glenii Dybowski, 1877	amur sleeper	freshwater, brackishwater	absent	Scenario 2	detection
Trachemys scripta (Thunberg In Schoepff, 1792)	common slider	freshwater	widespread		abundance under management, abundance, distribution
Lithobates catesbeianus (Shaw, 1802)	American bull frog	freshwater, terrestrial	established to limited extend		abundance under management, abundance, distribution
Nyctereutes procyonoides (Gray, 1834)	Asiatic raccoon	terrestrial	sporadically present		detection

the species to be taken forward for proof of concept monitoring design, without providing justifications for those not selected. For the selected species, the rationale for inclusion and the general contours of the - according to the steering committee - most required monitoring schemes were briefly discussed. Their exact design and implementation will be addressed in a next phase, relying on the INBO guidelines for designing policy-oriented monitoring schemes (Wouters *et al.*, 2008).

5.2.4.1 Chinese muntjac

The first species chosen was the *Chinese muntjac*. The selection was based on several reasons. An invasive population of the species is already present in Flanders, with a currently limited but potentially expanding distribution. Moreover, the species is already the subject of ongoing management efforts led by ANB. Importantly, this Flemish population is one of the few established populations on the European mainland, making its monitoring particularly relevant in a continental context. The Chinese muntjac is known to have significant ecological impacts, as demonstrated in the United Kingdom, where the species has become widespread and abundant.

For the Chinese muntjac, the selected monitoring scope is abundance under management, aligned with the objective of eradicating the species from its current range in part of the province of Antwerp. The monitoring scheme must be capable of tracking reductions in absolute abundance in response to management actions and verifying when the species has been fully eradicated - transitioning from monitoring abundance to monitoring presence-absence. However, some complexities were noted. While the species is known to occur in the region, its precise distribution remains unclear, with a mix of confirmed, suspected, and potential distribution sites. Moreover, the species' mobility in response to control efforts adds an extra challenge, as individuals may relocate rather than disappear. Consequently, although the main focus remains on abundance under management, additional monitoring efforts are needed to follow-up the species' distribution and enable detection in bordering not yet invaded areas.

5.2.4.2 Common slider

The second species selected is the *common slider*, a turtle species commonly released into the wild through pet trade. While there are currently no confirmed reproducing populations in Flanders, large numbers of individuals have been observed in the wild. The species is long-lived, can cause ecological damage, and with climate change, the chances of successful reproduction in Flanders are expected to increase. This was seen as an opportune moment to begin systematic monitoring before the species becomes fully established and invasive.

Two monitoring scopes are relevant for this species. First, scope distribution: there is a need for a clearer picture of where the species is currently present across water bodies in Flanders, hence an inventory. Once a better understanding of the species' current distribution is established, a full distribution monitoring scheme can be considered. Second, scope abundance under management: the species is already the target of local management efforts at certain sites. A monitoring scheme is needed to assess changes in abundance in response to these actions. Such a scheme could be developed as a proof of concept, implemented in a selection of managed sites.

5.2.4.3 American bull frog

The third species selected as a priority is the *American bull frog*, which is already established in Flanders. Although its overall distribution remains limited to specific sites, the species can be locally abundant within its invaded range. The bullfrog is currently the subject of active management by ANB, in collaboration with various partners and funded through multiple projects. Preliminary monitoring is already in place, primarily using eDNA-based approaches.

The most important monitoring scope identified by the committee for this species is abundance under management. Within the currently invaded zones, the aim is to assess whether different management strategies lead to measurable reductions in abundance over time. A secondary but complementary need is for improved data on distribution. This applies both to identifying which specific water bodies within the invaded area are currently occupied, and to detecting any expansion into new areas. This inventory/distribution monitoring is crucial to evaluate whether the species can be effectively contained within its current range.

The case of the American bull frog shares certain features with that of the Chinese muntjac - namely, a combination of management-related monitoring and a need to clarify distribution boundaries - but differs in that the bullfrog is at a more advanced stage of invasion and is already widely established within its core range.

5.2.4.4 Large-flower and floating primrose-willow

The final species group selected for prioritisation includes both the *large-flower primrose-willow* and the *floating primrose-willow*. Both species are already present in Flanders, with the latter having a more limited distribution, while the first is already widespread and continuing to expand its invasion range. Both species are currently subject to management by VMM.

The main monitoring scope for this group is abundance under management. Due to the species' ability to regenerate from small plant fragments, successful management is challenging, and monitoring is essential to determine whether local populations are truly eradicated or simply reduced temporarily. A monitoring scheme would need to be sensitive enough to detect regrowth and re-establishment, particularly in managed water bodies.

Given the current distribution of invasive water primroses, the proposed monitoring approach will likely involve proof of concept case studies, focusing on selected sites where active management is taking place, as well as comparative sites without intervention. This will allow for the evaluation of management effectiveness in reducing abundance and achieving local eradication, and could help inform future scaling of monitoring efforts across the Flemish region.

5.2.5 Concluding remarks on method-based synergies

The steering committee expressed agreement with the employed survey-based framework including the prioritisation process, and with the final selection of the four species outlined above. At the same time, the committee emphasized the importance of further exploring method-based synergies across species. In particular, for the Chinese muntjac, it was noted that the likely use of a camera trap network presents an opportunity to design monitoring schemes that could generate insights applicable to other invasive mammal species. The committee recommended that the development of this monitoring scheme be carried out with a view toward broader applicability - specifically to species such as the *Asiatic raccoon*, *common raccoon*, and possibly even (potentially) invasive squirrel species - in order to enhance efficiency and integration across future monitoring efforts.

For the American bull frog, the steering committee agreed that an eDNA-based monitoring approach is likely the most appropriate method. It was emphasized that the design of this monitoring scheme should aim to be broadly applicable to other species that are also amenable to detection via eDNA. A key example is the *African clawed frog*, which is also invasive in Flanders but currently at an earlier stage of invasion and with a more limited distribution. Like the American bull frog, the African clawed frog is subject to management by ANB. While the American bull frog was prioritised in this exercise due to the presence of ongoing monitoring and project-based management, both species are considered important. The committee stressed that the eDNA-based scheme developed for the bullfrog should be compatible with future monitoring schemes for the African clawed frog, and ideally also extendable to other aquatic IAS detectable through eDNA techniques.

The steering committee also wished to make special note of invasive crayfish species, which were not retained as priority species in this exercise despite their ecological relevance and the fact that several species are actively managed by ANB. Their absence reflects the current situation: there is already some monitoring under way through the Craywatch citizen science project (INBO & ANB, s.d.), and as such, they did not meet the strict prioritisation criteria used to narrow down the selection to four species. However, the committee emphasized that this monitoring remains project-based and not structurally embedded. In light of the proposed eDNA-based monitoring for the American bull frog and the African clawed frog, the committee strongly encouraged exploring to what extent eDNA methods can be generalized across aquatic invasive animal species. In this context, crayfish are considered a key candidate group for testing method-based synergies and assessing the practical feasibility of multi-species eDNA monitoring in the field.

For both the Common slider and the Water primroses, the expert survey highlighted the potential for method-based synergies, particularly through visual surveys that could be shared with other species. However, the steering committee noted that the real-world feasibility of these synergies remains uncertain. To assess how practical and effective such visual survey synergies would be in actual field conditions, a more in-depth study is required. While this kind of methodological assessment is generally foreseen for the next phase of the work, the committee agreed that for these two species in particular, such a targeted evaluation should be undertaken early on, to clarify the extent to which shared survey strategies can be realistically implemented.

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A EXPERT SURVEY DESIGN

A.1 SPECIES COVERED

The following table provides an overview over all species covered by the expert survey. Entries are greyed out if the survey was sent out but not completed. All scientific names are the currently accepted scientific names according to GBIF (The Global Biodiversity Information Facility, 2025). Vernacular names have largely also been retrieved from GBIF or filled in by species experts otherwise.

Table A.1: All species covered in the expert survey

Species on union list 2022	Species on union list 2025	Accepted scientific name	Vernacular name eng	Vernacular name nld	Kingdom	Taxon	Prius invasion stage	Prius milieu
FALSE	TRUE	Acacia mearnsii De Wild.	black wattle	zwarte wattle	plant	plant	REL-AFW	terrestrial
TRUE	TRUE	Acacia saligna (Labill.) H.L.Wendl.	golden wreath wattle	wilgacacia	plant	plant	REL-AFW	terrestrial
FALSE	TRUE	Acridotheres cristatellus (Linnaeus, 1758)	Chinese jungle mynah	kuifmaina	animal	bird	REL-AAN-SPO	terrestrial
TRUE	TRUE	Acridotheres tristis (Linnaeus, 1766)	common myna	treurmaina	animal	bird	REL-AAN-SPO	terrestrial
TRUE	TRUE	Ailanthus altissima (Mill.) Swingle	China-sumac	hemelboom	plant	plant	REL-AAN-GEV-VER-BUI	terrestrial
TRUE	TRUE	Alopochen aegyptiaca (Linnaeus, 1766)	Egyptian goose	nijlgans	animal	bird	REL-AAN-GEV-VER-BUI	terrestrial, freshwater, brackishwater
TRUE	TRUE	Alternanthera philoxeroides (Mart.) Griseb.	alligator weed	alligatorkruid	plant	plant	REL-AFW	freshwater, terrestrial
TRUE	TRUE	Ameiurus melas (Rafinesque, 1820)	black bullhead	zwarte Amerikaanse dwergmeerval	animal	fish	REL-AAN-SPO	freshwater
TRUE	TRUE	Andropogon virginicus L.	broom-sedge	Amerikaans bezemgras	plant	plant	REL-AFW	terrestrial
TRUE	TRUE	Arthurdendyus triangulatus (Dendy, 1895)	New Zealand flatworm	Nieuw-Zeelandse platworm	animal	flatworm	REL-AFW	terrestrial
TRUE	TRUE	Asclepias syriaca L.	common milkweed	zijdeplant	plant	plant	REL-AAN-SPO	terrestrial
FALSE	TRUE	Asterias amurensis Lutken, 1871	flat-bottomed star	Noord-Atlantische zeester	animal	echinoderm	REL-AFW	marine
TRUE	TRUE	Axis axis (Erxleben, 1777)	axis deer	axishert	animal	mammal	REL-AFW	terrestrial
TRUE	TRUE	Baccharis halimifolia L.	consumption-weed	struikaster	plant	plant	REL-AAN-GEV-BEP	terrestrial, brackishwater
FALSE	TRUE	Bipalium kewense Moseley, 1878	hammerhead flatworm	hamerhoofdplatworm	animal	flatworm	REL-AAN-SPO	terrestrial
FALSE	TRUE	Broussonetia papyrifera (L.) L'Hér. ex Vent.	paper mulberry	papiermoerbei	plant	plant	REL-AAN-SPO	terrestrial
TRUE	TRUE	Cabomba caroliniana A.Gray	Carolina water-shield	waterwaaier	plant	plant	REL-AAN-SPO	freshwater
TRUE	TRUE	Callosciurus erythraeus (Pallas, 1779)	Pallas's squirrel	Pallas' eekhoorn	animal	mammal	REL-AAN-SPO	terrestrial
TRUE	TRUE	Callosciurus finlaysonii (Horsfield, 1823)	Finlayson's squirrel	Thaise eekhoorn	animal	mammal	REL-AFW	terrestrial
TRUE	TRUE	Cardiospermum grandiflorum Sw.	balloon vine	ballonrank	plant	plant	REL-AFW	terrestrial
FALSE	TRUE	Castor canadensis Kuhl, 1820	American beaver	Amerikaanse bever	animal	mammal	REL-AFW	terrestrial
TRUE	TRUE	Celastrus orbiculatus Thunb.	Asian bittersweet	Aziatische boomwurger	plant	plant	REL-AAN-SPO	terrestrial
TRUE	TRUE	Cenchrus setaceus (Forssk.) Morrone	crimson fountaingrass	fraai lampenpoetsergras	plant	plant	REL-AAN-SPO	terrestrial
FALSE	TRUE	Cervus nippon Temminck, 1838	sika deer	sikahert	animal	mammal	REL-AAN-GEV-BEP	terrestrial

(continued)

Species on union list 2022	Species on union list 2025	Accepted scientific name	Vernacular name eng	Vernacular name nld	Kingdom	Taxon	Prius invasion stage	Prius milieu
TRUE	TRUE	Channa argus (Cantor, 1842)	amur snakehead	Noordelijke slangekopvis	animal	fish	REL-AFW	freshwater
FALSE	TRUE	Cherax destructor Clark, 1936	Australian yabbi	gewone yabby	animal	crustacean	REL-AAN-SPO	freshwater
FALSE	TRUE	Cipangopaludina chinensis (J.E.Gray, 1833)	black snail	Chinese moerasslak	animal	mollusk	REL-AAN-SPO	freshwater
TRUE	TRUE	Cortaderia jubata (Lemoine) Stapf	Andean pampas grass	hoog pampasgras	plant	plant	REL-AFW	terrestrial
TRUE	TRUE	Corvus splendens Vieillot, 1817	house crow	huiskraai	animal	bird	REL-AFW	terrestrial
FALSE	TRUE	Crassula helmsii (Kirk) Cockayne	Australian swamp stonecrop	watercrassula	plant	plant	REL-AAN-GEV-VER-NAT	freshwater, terrestrial
FALSE	TRUE	Delairea odorata Lem.	Cape ivy	klimopkruiskruid	plant	plant	REL-AFW	terrestrial
TRUE	TRUE	Ehrharta calycina Sm.	perennial veldtgrass	roze rimpelgras	plant	plant	REL-AFW	terrestrial
TRUE	TRUE	Elodea nuttallii (Planch.) H.St.John	nutall waterweed	smalle waterpest	plant	plant	REL-AAN-GEV-VER-NAT	freshwater
TRUE	TRUE	Eriocheir sinensis H.Milne Edwards, 1853	Chinese mitten crab	Chinese krab	animal	crustacean	REL-AAN-GEV-VER-NAT	freshwater, brackishwater, marine
FALSE	TRUE	Faxonius immunis (Hagen, 1870)	calico crayfish	calicotrivierkreeft	animal	crustacean	REL-AFW	freshwater
TRUE	TRUE	Faxonius limosus (Rafinesque, 1817)	spiny-cheek crayfish	gevlekte rivierkreeft	animal	crustacean	REL-AAN-GEV-VER-BUI	freshwater
TRUE	TRUE	Faxonius rusticus (Girard, 1852)	rusty crayfish	roestbruine Amerikaanse rivierkreeft	animal	crustacean	REL-AFW	freshwater
TRUE	TRUE	Faxonius virilis (Hagen, 1870)	northern crayfish	geknobbelde Amerikaanse rivierkreeft	animal	crustacean	REL-AAN-SPO	freshwater
TRUE	TRUE	Fundulus heteroclitus (Linnaeus, 1766)	killifish	mummichog	animal	fish	IRR	freshwater, brackishwater, marine
TRUE	TRUE	Gambusia affinis (Baird & Girard, 1853)	live-bearing tooth-carp	Westelijk muskietenvisje	animal	fish	REL-AFW	freshwater, brackishwater
TRUE	TRUE	Gambusia holbrooki Girard, 1859	bore-drain fish	Oostelijk muskietenvisje	animal	fish	REL-AFW	freshwater, brackishwater
TRUE	TRUE	Gunnera tinctoria (Molina) Mirb.	Chilean gunnera	gewone gunnera	plant	plant	REL-AAN-SPO	terrestrial
TRUE	TRUE	Gymnocoronis spilanthoides DC.	Senegal tea plant	smalle theeplant	plant	plant	REL-AFW	terrestrial
TRUE	TRUE	Hakea sericea Schrad. & J.C.Wendl.	bushy needlewood	hakea	plant	plant	REL-AFW	terrestrial
TRUE	TRUE	Heracleum mantegazzianum Sommier & Levier	cartwheel-flower	reuzenbereklauw	plant	plant	REL-AAN-GEV-VER-BUI	terrestrial
TRUE	TRUE	Heracleum persicum Desf.	Persian hogweed	Perzische berenklauw	plant	plant	REL-AFW	terrestrial
TRUE	TRUE	Heracleum sosnowskyi Manden.	Sosnowsky's hogweed	Sosnowsky's berenklauw	plant	plant	REL-AFW	terrestrial

(continued)

Species on union list 2022	Species on union list 2025	Accepted scientific name	Vernacular name eng	Vernacular name nld	Kingdom	Taxon	Prius invasion stage	Prius milieu
TRUE	TRUE	Herpestes javanicus (É.Geoffroy Saint-Hilaire, 1818)	Indian mongoose	Indische mangoeste	animal	mammal	REL-AFW	terrestrial
TRUE	TRUE	Humulus scandens (Lour.) Merr.	Japanese hop	Oosterse hop	plant	plant	REL-AFW	terrestrial
TRUE	TRUE	Hydrocotyle ranunculoides L.fil.	floating pennywort	grote waternavel	plant	plant	REL-AAN-GEV-VER-BUI	freshwater
TRUE	TRUE	Impatiens glandulifera Royle	Himalayan balsam	reuzenbalsemien	plant	plant	REL-AAN-GEV-VER-BUI	terrestrial
TRUE	TRUE	Koenigia polystachya (Wall. ex Meisn.) T.M.Schust. & Reveal	Himalayan knotweed	Afghaanse duizendknoop	plant	plant	REL-AAN-GEV-BEP	terrestrial
TRUE	TRUE	Lagarosiphon major (Ridl.) Moss	African elodea	verspreidbladige waterpest	plant	plant	REL-AAN-GEV-BEP	freshwater
TRUE	TRUE	Lampropeltis getula (Linnaeus, 1766)	common kingsnake	gewone koningsslang	animal	reptile	REL-AFW	terrestrial
TRUE	TRUE	Lepomis gibbosus (Linnaeus, 1758)	common sunfish	zonnebaars	animal	fish	REL-AAN-GEV-VER-NAT	freshwater, brackishwater
TRUE	TRUE	Lespedeza cuneata (Dum.Cours.) G.Don	Chinese bush-clover	Chinese struikklaver	plant	plant	REL-AFW	terrestrial
TRUE	TRUE	Limnoperna fortunei (Dunker, 1857)	golden mussel	gouden mossel	animal	mollusk	REL-AFW	freshwater
TRUE	TRUE	Lithobates catesbeianus (Shaw, 1802)	American bull frog	Amerikaanse stierkikker	animal	amphibian	REL-AAN-GEV-BEP	freshwater, terrestrial
TRUE	TRUE	Ludwigia grandiflora (Michx.) Greuter & Burdet	large-flower primrose-willow	waterteunisbloem	plant	plant	REL-AAN-GEV-VER-NAT	freshwater
TRUE	TRUE	Ludwigia peploides (Kunth) P.H.Raven	floating primrose-willow	kleine waterteunisbloem	plant	plant	REL-AAN-GEV-BEP	freshwater
TRUE	TRUE	Lygodium japonicum (Thunb.) Sw.	Japanese climbing fern	Japanse klimvaren	plant	plant	REL-AFW	terrestrial
TRUE	TRUE	Lysichiton americanus Hultén & H.St.John	American skunk-cabbage	moerasaronskelk	plant	plant	REL-AAN-SPO	freshwater, terrestrial
FALSE	TRUE	Marisa cornuarietis (Linnaeus, 1758)	Colombian ramshorn apple snail	grote posthorenappelslak	animal	mollusk	REL-AFW	freshwater
TRUE	TRUE	Microstegium vimineum (Trin.) A.Camus	Chinese packing grass	Japans steltgras	plant	plant	REL-AAN-SPO	terrestrial
FALSE	TRUE	Misgurnus anguillicaudatus (Cantor, 1842)	amur mud loach	Chinese weeraal	animal	fish	REL-AAN-SPO	freshwater
FALSE	TRUE	Misgurnus mohoity (Dybowski, 1869)	amur weatherfish	Noord-Aziatische modderkruiper	animal	fish	REL-AAN-SPO	freshwater
TRUE	TRUE	Morone americana (Gmelin, 1789)	Maryland bass hybrid	Amerikaanse baars	animal	fish	IRR	freshwater, brackishwater, marine
FALSE	TRUE	Mulinia lateralis (Say, 1822)	dwarf surfclam	Amerikaanse strandschelp	animal	mollusk	REL-AAN-GEV-BEP	marine

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(continued)

Species on union list 2022	Species on union list 2025	Accepted scientific name	Vernacular name eng	Vernacular name nld	Kingdom	Taxon	Prius invasion stage	Prius milieu
TRUE	TRUE	Muntiacus reevesi (Ogilby, 1839)	Chinese muntjac	Chinese muntjak	animal	mammal	REL-AAN-GEV-BEP	terrestrial
FALSE	TRUE	Mustela vison Schreber, 1777	American mink	Amerikaanse nerts	animal	mammal	REL-AAN-GEV-BEP	freshwater, terrestrial
TRUE	TRUE	Myocastor coypus (Molina, 1782)	coypu	beverrat	animal	mammal	REL-AAN-GEV-BEP	freshwater, terrestrial
TRUE	TRUE	Myriophyllum aquaticum (Vell.) Verdc.	Brazilian water-milfoil	parelvederkruid	plant	plant	REL-AAN-GEV-VER-NAT	freshwater
TRUE	TRUE	Myriophyllum heterophyllum Michx.	broadleaf water-milfoil	ongelijbladig vederkruid	plant	plant	REL-AAN-GEV-BEP	freshwater
TRUE	TRUE	Nasua nasua (Linnaeus, 1766)	brown-nosed coati	neusbeer	animal	mammal	REL-AFW	terrestrial
TRUE	TRUE	Nyctereutes procyonoides (Gray, 1834)	Asiatic raccoon	wasbeerhond	animal	mammal	REL-AAN-SPO	terrestrial
FALSE	TRUE	Obama nungara Carbayo, Alvarez-Presas, Jones & Riutort, 2016	Obama flatworm	grote gevlekte landplatworm	animal	flatworm	REL-AAN-SPO	terrestrial
TRUE	TRUE	Ondatra zibethicus (Linnaeus, 1766)	muskrat	muskusrat	animal	mammal	REL-AAN-GEV-VER-BUI	freshwater, terrestrial
TRUE	TRUE	Oxyura jamaicensis (J.F.Gmelin, 1789)	ruddy duck	rosse stekelstaart	animal	bird	REL-AAN-SPO	freshwater
FALSE	TRUE	Pachycondyla chinensis (Emery, 1895)	Asian needle ant	Aziatische naaldmier	animal	insect	REL-AFW	terrestrial
TRUE	TRUE	Pacifastacus leniusculus (Dana, 1852)	signal crayfish	Californische rivierkreeft	animal	crustacean	REL-AAN-SPO	freshwater
TRUE	TRUE	Parthenium hysterophorus L.	mugwort	schijnambrosia	plant	plant	REL-AFW	terrestrial
TRUE	TRUE	Perccottus glenii Dybowski, 1877	amur sleeper	amurgrondel	animal	fish	REL-AFW	freshwater, brackishwater
TRUE	TRUE	Persicaria perfoliata (L.) H.Gross	Asian tearthumb	gestekelde duizendknoop	plant	plant	REL-AFW	terrestrial
TRUE	TRUE	Pistia stratiotes L.	lettuce water	watersla	plant	plant	REL-AAN-GEV-BEP	freshwater
FALSE	TRUE	Platydemus manokwari Beauchamp, 1962	New Guinea flatworm	Nieuw-Guinese landplatworm	animal	flatworm	REL-AFW	terrestrial
TRUE	TRUE	Plotosus lineatus (Thunberg, 1787)	barbel-eel catfish	gestreepte koraalmeerval	animal	fish	IRR	brackishwater, marine
TRUE	TRUE	Pontederia crassipes Mart.	water-hyacinth	waterhyacint	plant	plant	REL-AAN-SPO	freshwater
TRUE	TRUE	Procambarus clarkii (Girard, 1852)	red swamp crayfish	rode Amerikaanse rivierkreeft	animal	crustacean	REL-AAN-GEV-VER-BUI	freshwater, brackishwater
TRUE	TRUE	Procambarus virginalis Lyko, 2017	marbled crayfish	marmerkreeft	animal	crustacean	REL-AAN-GEV-BEP	freshwater

(continued)

Species on union list 2022	Species on union list 2025	Accepted scientific name	Vernacular name eng	Vernacular name nld	Kingdom	Taxon	Prius invasion stage	Prius milieu
TRUE	TRUE	Procyon lotor (Linnaeus, 1758)	common raccoon	wasbeer	animal	mammal	REL-AAN-GEV-BEP	terrestrial
TRUE	TRUE	Prosopis juliflora (Sw.) DC.	mesquite	mesquite	plant	plant	REL-AFW	terrestrial
TRUE	TRUE	Pseudorasbora parva (Temminck & Schlegel, 1846)	false razbora	blauwband	animal	fish	REL-AAN-GEV-VER-BUI	freshwater, brackishwater
TRUE	TRUE	Pueraria montana (Lour.) Merr.	kudzu	kudzu	plant	plant	REL-AFW	terrestrial
TRUE	TRUE	Pycnonotus cafer (Linnaeus, 1766)	red-vented bulbul	roodbuikbuulbuul	animal	bird	REL-AFW	terrestrial
FALSE	TRUE	Pycnonotus jocosus (Linnaeus, 1758)	red-whiskered bulbul	roodoorbuulbuul	animal	bird	REL-AAN-SPO	terrestrial
FALSE	TRUE	Reynoutria japonica Houtt., Reynoutria sachalinensis (F.Schmidt) Nakai, Reynoutria ×bohemica Chrtek & Chrtková	Asian, giant, Bohemian knotweed	Japanse, Sachalinse, Boheemse duizendknoop	plant	plant	REL-AAN-GEV-VER-BUI	terrestrial
TRUE	TRUE	Rugulopteryx okamurae (E.Y.Dawson) I.K.Hwang, W.J.Lee & H.S.Kim, 2009	algae stomp	gaffelwier	plant	brownweed	IRR	marine
TRUE	TRUE	Salvinia ×molesta D.S.Mitch.	African payal	grote vlotvaren	plant	plant	REL-AFW	freshwater
TRUE	TRUE	Sciurus carolinensis Gmelin, 1788	eastern grey squirrel	grijze eekhoorn	animal	mammal	REL-AAN-SPO	terrestrial
TRUE	TRUE	Sciurus niger Linnaeus, 1758	fox squirrel	Amerikaanse voseekhoorn	animal	mammal	REL-AAN-SPO	terrestrial
TRUE	TRUE	Solenopsis geminata (Fabricius, 1804)	fire ant	tropische vuurmier	animal	insect	REL-AFW	terrestrial
TRUE	TRUE	Solenopsis invicta Buren, 1972	red imported fire ant	rode vuurmier	animal	insect	REL-AFW	terrestrial
TRUE	TRUE	Solenopsis richteri Forel, 1909	black imported fire ant	zwarte vuurmier	animal	insect	REL-AFW	terrestrial
TRUE	TRUE	Tamias sibiricus (Laxmann, 1769)	Siberian chipmunk	Aziatische grondeekhoorn	animal	mammal	REL-AAN-GEV-BEP	terrestrial
TRUE	TRUE	Threskiornis aethiopicus (Latham, 1790)	African sacred ibis	heilige ibis	animal	bird	REL-AAN-SPO	terrestrial, freshwater, brackishwater
TRUE	TRUE	Trachemys scripta (Thunberg In Schoepff, 1792)	common slider	lettersierschildpad	animal	reptile	REL-AAN-GEV-VER-BUI	freshwater
TRUE	TRUE	Triadica sebifera (L.) Small	Chinese tallow	talgboom	plant	plant	REL-AFW	terrestrial
FALSE	TRUE	Vespa mandarinia Smith, 1852	Asian giant hornet	Japanse reuzenhoornaar	animal	insect	REL-AFW	terrestrial
TRUE	TRUE	Vespa velutina nigrithorax Buysson, 1905	Asian hornet	Aziatische hoornaar	animal	insect	REL-AAN-GEV-VER-BUI	terrestrial
TRUE	TRUE	Wasmannia auropunctata (Roger, 1863)	little fire ant	dwergvuurmier	animal	insect	REL-AFW	terrestrial

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Species on union list 2022	Species on union list 2025	Accepted scientific name	Vernacular name eng	Vernacular name nld	Kingdom	Taxon	Prius invasion stage	Prius milieu
TRUE	TRUE	Xenopus laevis (Daudin, 1802)	African clawed frog	Afrikaanse klauwkikker	animal	amphibian	REL-AAN-GEV-BEP	freshwater
FALSE	TRUE	Zostera japonica Asch. & Graebn.	dwarf eelgrass	Japanese eelgrass	plant	plant	REL-AFW	marine
FALSE	FALSE	Aedes albopictus (Skuse, 1894)	Asian tiger mosquito	Aziatische tijgermug	animal	insect	IRR	terrestrial
FALSE	FALSE	Ambrosia artemisiifolia L.	annual ragweed	alsemambrosia	plant	plant	IRR	terrestrial
FALSE	FALSE	Branta canadensis (Linnaeus, 1758)	Canada goose	Canadese gans	animal	bird	REL-AAN-GEV-VER-BUI	freshwater, terrestrial
FALSE	FALSE	Callinectes sapidus Rathbun, 1896	American blue crab	blauwe krab	animal	crustacean	REL-AAN-SPO	marine, brackishwater, freshwater
FALSE	FALSE	Cherax quadricarinatus (von Martens, 1868)	Australian redclaw crayfish	Australische roodklauwkreeft	animal	crustacean	REL-AFW	freshwater
FALSE	FALSE	Cortaderia selloana (Schult. & Schult.f.) Asch. & Graebn.	pampas grass	pampagras	plant	plant	REL-AAN-GEV-BEP	terrestrial
FALSE	FALSE	Myiopsitta monachus (Boddaert, 1783)	monk parakeet	monniksparkiet	animal	bird	REL-AAN-SPO	terrestrial
FALSE	FALSE	Tradescantia fluminensis Vell.	small-leaf spiderwort	vaderplant	plant	plant	REL-AAN-SPO	terrestrial

A.2 QUESTIONNAIRE

A.2.1 Preface

A.2.1.1 Are you interested in the results of this survey? If so, please provide your e-mail address.

A.2.1.2 Which species are you reporting on?

- [list with invasive alien species]

A.2.1.3 Which invasion stage is the species in in Flanders?

- absent
- sporadically present
- established to limited extend
- widespread

A.2.2 Introduction & establishment

A.2.2.1 How many current and potential introduction sites are there and how widespread are these?

Introduction sites refer to locations related to routes through which the species enters Flanders, such as through transportation, trade, ornamental plants, domestic animals and other human activities. This also includes the natural spread of invasive populations from neighbouring countries into Flanders. Choose one of the following options.

- limited number of specific locations (e.g. seaports)
- large number of widespread locations (e.g. freshwater bodies if the species is mainly released from aquaria)
- both specific and widespread locations
- unknown
- I do not know

Optional: Briefly explain the chosen answer (e.g. which introduction sites are mainly concerned) and indicate any sources used.

A.2.2.2 How accessible are the current and potential introduction sites?

Choose one of the following options.

- mainly publicly accessible domains
- mainly publicly non-accessible domains (e.g. private, commercial, military domains)
- both publicly accessible and non-accessible domains
- unknown
- I do not know

Optional: Briefly explain the chosen answer and indicate any sources used.

A.2.2.3 Are there within the current or potential introduction sites of the species locations that need special attention for some reason?

Reply via a concise free text. Please indicate the reason for your selection.

A.2.2.4 How large is the probability that the species will be introduced in Flanders in the next 10 years?

The question focuses on the probability of introduction through the current and potential introduction sites of the species. The distribution in neighbouring countries may also serve to estimate the probability of introduction. Choose one of the following options.

- large probability
- medium probability
- small probability
- unknown
- I do not know

Optional: Briefly explain the chosen answer and indicate any sources used.

A.2.2.5 How large is the probability that the species becomes established in Flanders?

The probability of a species becoming established depends, among other things, on climate and habitat requirements and other ecological characteristics of the species (e.g. generalist or specialist, capacity for rapid population growth). Invasion stages in neighbouring countries or in countries with similar climate and habitat conditions may also serve to estimate the climate and habitat match for Flanders. Choose one of the following options.

- large probability
- medium probability
- small probability
- unknown
- I do not know

Optional: Briefly explain the answer chosen (e.g. which ecological characteristics are important) and indicate any sources used.

A.2.3 Distribution & abundance

A.2.3.1 Is the distribution of the species across Flanders sufficiently known?

The above distribution map is based on GBIF data. For the Flemish Region (area within the solid line) and a 30 km wide buffer zone (area between solid and dotted line), we mark those grid cells (EEA Reference grid, 1 x 1 km) in red within which the species has been observed during the last 10 years. You can zoom in and out using the keyboard shortcuts Ctrl + and Ctrl -. Choose one of the following options.

- yes, the distribution is sufficiently known and the distribution map is representative of it
- yes, the distribution is sufficiently known but the distribution map is not representative of it
- no, the distribution is not sufficiently known
- I do not know

Optional: Briefly explain the answer chosen (e.g. which occurrences may not be on the map) and indicate any sources used.

A.2.3.2 What is the current and potential distribution pattern across Flanders?

The potential distribution pattern can be estimated from the species' habitat preferences, and the extent to which these habitats occur in Flanders. Choose one of the following options.

- the species is locally distributed and may also only occur at a limited number of sites in Flanders
- the species is locally distributed but could potentially spread widely across Flanders
- the species is widespread and can thus found at many sites in Flanders
- unknown
- I do not know

Optional: Briefly explain the chosen answer and indicate any sources used.

A.2.3.3 What is the current and potential population density of the species?

Choose one of the following options.

- the species has reached, or has the potential to reach, a high population density
- the species has reached, or has the potential to reach, a medium population density
- the species has reached, or has the potential to reach, a low population density
- unknown
- I do not know

Optional: Briefly explain the chosen answer and indicate any sources used.

A.2.3.4 What level of change in the current distribution sites can be expected within 10 years?

This assessment takes into account factors such as the climate and habitat requirements of the species, the capacity of the species to spread in an area (dispersal capacity), and the expected further spread by human activity or from abroad into Flanders. Current or already planned management measures may also play a role. Choose one of the following options.

- small change expected (few additional distribution sites)

- medium change expected (medium number of additional distribution sites)
- large change expected (many additional distribution sites, change in distribution pattern from local to widespread)
- unknown
- I do not know

Optional: Briefly explain the answer chosen (e.g. which factors mainly determined the assessment) and indicate any sources used.

A.2.3.5 How accessible are the current and potential distribution sites?

Choose one of the following options.

- mainly publicly accessible domains
- mainly publicly non-accessible domains (e.g. private, commercial, military domains)
- both publicly accessible and non-accessible domains
- unknown
- I do not know

Optional: Briefly explain the chosen answer and indicate any sources used.

A.2.3.6 Are there within the current or potential distribution sites of the species locations that need special attention for some reason?

Reply via a concise free text. Please indicate the reason for your selection.

A.2.4 Impact

A.2.4.1 What level of negative impact of the species can be expected on biodiversity and ecosystem services in Flanders?

This question assumes that the species is or will be invasive and occupy suitable areas in Flanders. For species already present, this can be based on actual observed effects. For other species, the estimate may be based on similar situations in other countries, the ecology of the species, similarity to other invasive species, or other relevant factors. Choose one of the following options.

- large negative impact expected
- medium negative impact expected
- small negative impact expected
- not applicable as species is unlikely to become invasive in Flanders within 10 years
- unknown
- I do not know

Optional: Briefly explain the chosen answer (e.g. which impact mechanisms are mainly at play) and indicate any sources used.

A.2.4.2 To what extent will the expected negative impact of the species on biodiversity and ecosystem services manifest in conservation or Natura 2000 areas?

Choose one of the following options.

- mainly in conservation or Natura 2000 areas
- mainly outside conservation or Natura 2000 areas
- both inside and outside conservation or Natura 2000 areas
- not applicable as species is unlikely to become invasive in Flanders within 10 years
- unknown
- I do not know

Optional: Briefly explain the chosen answer and indicate any sources used.

A.2.4.3 What level of negative impact of the species can additionally be expected in other domains?

This question concerns the expected negative impact across various other domains, such as agriculture, economy, public health and other relevant sectors, and asks for an assessment of the overall impact. Choose one of the following options.

- large negative impact expected
- medium negative impact expected
- small negative impact expected
- not applicable as species is unlikely to become invasive in Flanders within 10 years
- unknown
- I do not know

Optional: Briefly explain the answer chosen (e.g. which domains are mainly concerned) and indicate any sources used

A.2.5 Surveillance

A.2.5.1 Which surveillance techniques are available for the species?

This may include, for example, the use of eDNA for invasive fish species or camera traps for nocturnal invasive mammals. Other examples may include other types of traps, visual surveys, or acoustic surveillance, depending on the species. Choose one or more of the following options.

- visual surveys
- acoustic surveys
- passive acoustic surveillance (through automatic recordings)
- camera traps
- pheromone traps
- light traps
- colored traps
- pitfall traps
- environmental DNA: water
- environmental DNA: soil
- environmental DNA: air
- electrofishing
- other

Optional: Briefly explain the answer chosen (e.g. what other surveillance techniques are available) and indicate any sources used.

A.2.5.2 Which of the surveillance techniques chosen above is the most relevant for the species?

Reply via a concise free text. Please indicate the reason for your selection.

A.2.5.3 What is the level of sensitivity of this most relevant surveillance technique?

The sensitivity indicates how well a method is able to detect the presence of a species or a minimally relevant (change in) population size. With a high sensitivity, the probability of detecting this presence is large if the species or a minimally relevant (change in) population size is actually present. A high sensitivity also leads to a small percentage of false-negative results. Choose one of the following options.

- high sensitivity
- medium sensitivity
- low sensitivity
- unknown
- I do not know

Optional: Briefly explain the answer chosen and indicate any sources used.

A.2.5.4 What is the level of specificity of this most relevant surveillance technique?

The specificity indicates how well a method can detect the absence of a species or a minimally relevant (change in) population size. With high specificity, the absence is likely to be detected if the species or minimum relevant (change in) population size is actually absent. High specificity also leads to a small percentage of false-positive results. Choose one of the following options.

- high specificity
- medium specificity
- low specificity
- unknown
- I do not know

Optional: Briefly explain the chosen answer and indicate any sources used.

A.2.5.5 How high are the costs of this most relevant surveillance technique?

Costs may be associated e.g. with the time to measure a sampling point, data processing, staff deployment, staff training and the use of equipment. Low costs apply e.g. when volunteers can easily observe the species or can do so with limited training by experts. Medium costs are expected e.g. when methods require specialised equipment and technical knowledge, such as eDNA analysis or the use of camera traps. High costs arise when e.g. genetic analyses are needed for cryptic species or e.g. when detailed morphological research by experts is required. Choose one of the following options.

- low costs
- medium costs
- high costs
- unknown
- I do not know

Optional: Briefly explain the chosen answer and indicate any sources used.

A.2.5.6 Is this most relevant surveillance technique mainly suited to determine the presence or absence of the species, or can absolute or relative numbers also be determined?

Choose one of the following options.

- presence or absence only
- also relative numbers
- also absolute (and relative) numbers
- unknown
- I do not know

Optional: Briefly explain the chosen answer and indicate any sources used.

A.2.5.7 Is there a standardised and optimised field protocol available?

A standardised field protocol clearly defines the entire measurement procedure and thus ensures objectivity. An optimised field protocol contains information on optimal times and weather conditions for measuring a species, thus ensuring a sufficient and stable detection probability. Choose one of the following options.

- yes
- yes, but the field protocol is only standardised
- yes, but the field protocol is only optimised
- no
- unknown
- I do not know

Briefly explain the chosen answer (e.g. which field protocol is concerned). Also indicate the sources used.

A.2.5.8 Which existing surveillance schemes in Flanders are relevant to the species?

We consider surveillance schemes relevant if they potentially or actually pick up the species. This can cover certain specific populations of the species as well as the entire distribution area. Choose one or more of the following options.

- Common Breeding Birds Project (Algemene Broedvogelmonitoring Vlaanderen)
- Flemish Butterfly Monitoring Scheme (Algemene vlindermonitoring)
- Rare Breeding Birds Project (Bijzondere Broedvogels Vlaanderen)
- Florabank
- Marten Network (Marternetwerk)
- Meetnetten.be
- Moth Monitoring Scheme (Nachtvlindermeetnet)
- Fish Monitoring Scheme (Vis Informatie Systeem)
- Wintering Waterbird Counts (Watervogeltellingen)
- Winter Bats Counts (Wintertellingen Vleermuizen)
- other
- none
- I do not know

Optional: Briefly explain the chosen answer (how the surveillance scheme is relevant and what the possible strengths and weaknesses are for detecting the species) and indicate any sources used.

A.2.5.9 To what extent do opportunistic observations (e.g. collected via waarnemingen.be) provide a representative picture of the species' distribution?

Choose one of the following options.

- high representativeness
- medium representativeness
- low representativeness
- unknown
- I do not know

Optional: Briefly explain the chosen answer and indicate any sources used.

A.2.6 Management

A.2.6.1 Is the species currently managed in Flanders?

This question addresses existing management measures, which may focus on: eradication under rapid response; containment of one or more established populations to avoid or further delay spread; keeping specific areas, such as conservation areas, pest-free; limiting the abundance of the species below a threshold level. Choose one of the following options.

- yes
- no
- unknown
- I do not know

Optional: Briefly explain the chosen answer (e.g., what management goals and measures are involved and where the species is managed) and indicate any sources used.

A.2.6.2 If it is decided to manage the species, or if the species is already managed in Flanders, what information is needed to evaluate the effectiveness of the management measures?

This question again deals with existing and or to be established management measures (see explanation of previous question). Depending on the measures chosen, an evaluation of effectiveness requires different types of information. Choose one of the following options.

- presence or absence of the species
- relative population size of the species
- absolute population size of the species
- no direct information on the species because other variables suffice (e.g. damage caused by species serves as proxy for population size)
- unknown
- I do not know

Optional: Briefly explain the chosen answer (e.g. what management measures are involved and what possible proxy variables are involved) and indicate any sources used.

A.3 INVITATION E-MAIL TEXT

The following e-mail text was used to invite species experts to participate in the survey.

> ***Subject: Survey on invasive alien species in Flanders***
>
> *Dear [name receiver],*
>
> *In connection with the project "Designing surveillance schemes for Invasive Alien Species" at the Research Institute for Nature and Forest we are conducting a survey among species experts. With this we would like to kindly ask you to participate in it.*
>
> *The survey is intended to take your expertise into account when planning future survey schemes for invasive alien species in Flanders. This includes the current list of invasive alien species of concern to the European Union (Invasive Alien Species of Union concern), as well as a number of species that may be added to this list in the future. You are not an expert for invasive alien species or the species listed below? In that case we have - based on recommendations from colleagues or literature research - come to the conclusion that you are probably still the most appropriate person to make statements about this or these (sometimes poorly known) species, in a Flemish context.*
>
> *For each species, a separate form has been prepared with questions on its (probability of) introduction and/or establishment, its distribution and abundance, its impact, its monitoring and its management. You obviously only need to fill in a form for the species listed below. For each species, this will take about 20 - 30 minutes. An overview of the full questionnaire can be found here: [link overview questions]*
>
> *We would greatly appreciate it if you could complete this survey before [date]. Should it be impossible for you to participate, we would appreciate it if you could recommend other experts who could help us further with the species below.*
>
> *The email address that you may provide with this survey will only be used to contact you regarding the results, given your explicit permission. When analyzing the survey results, personal data will be anonymized. Similarly, responses containing free text will not be disclosed verbatim but only in summarized form.*
>
> *Should you have any further questions or require further information, please do not hesitate to contact us. Thank you very much for your cooperation.*
>
> *Kind regards, [name sender]*
>
> *Link to the form for [species name]: [link form]*

A.4 SPECIES DISTRIBUTION MAPS

The question “Is the distribution of the species across Flanders sufficiently known?” was complemented by species-specific distribution maps based on recent data from GBIF (GBIF.Org User, 2024; The Global Biodiversity Information Facility, 2025).

A.4.1 Example distribution map for the Chinese muntjac

Here we show the distribution map of the Chinese muntjac as an example. For the Flemish Region (area within the solid line) and a 30 km wide buffer zone (area between solid and dotted line), we mark those grid cells (EEA Reference grid, 1 x 1 km) in red within which the Chinese muntjac has been observed between the years 2014 and 2024.

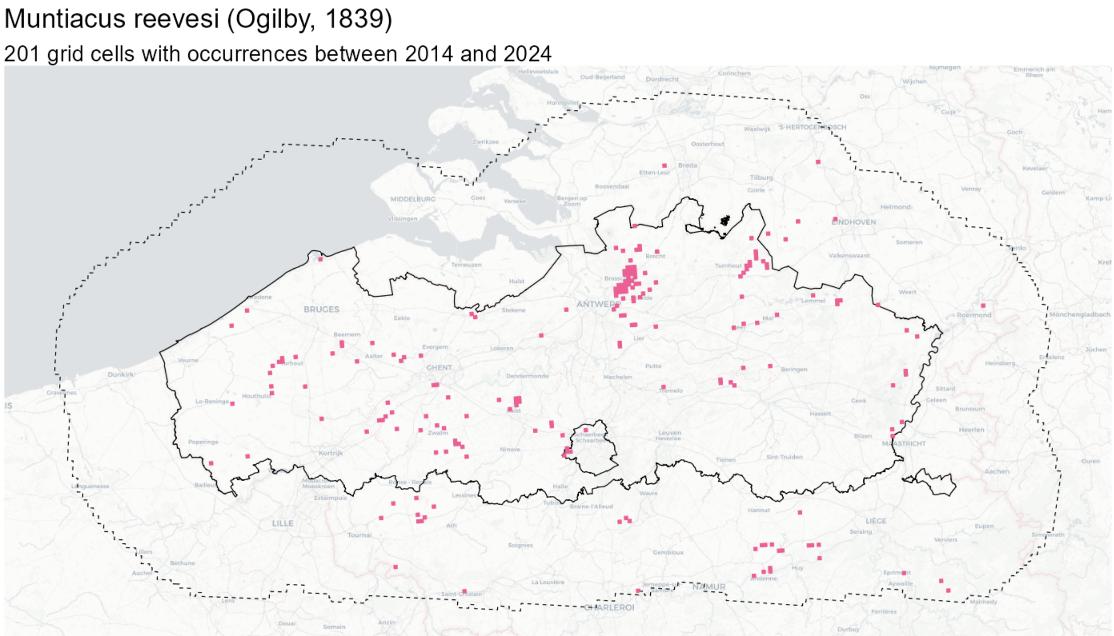

Figure A.1: Example occurrence map based on GBIF data

A.4.2 Distribution maps of all species

Distribution maps for all species are available as external png files under the following links:

- Acacia mearnsii De Wild.
- Acacia saligna (Labill.) H.L.Wendl.
- Acridotheres cristatellus (Linnaeus, 1758)
- Acridotheres tristis (Linnaeus, 1766)
- Aedes albopictus (Skuse, 1894)
- Ailanthus altissima (Mill.) Swingle
- Alopochen aegyptiaca (Linnaeus, 1766)
- Alternanthera philoxeroides (Mart.) Griseb.
- Ambrosia artemisiifolia L.
- Ameiurus melas (Rafinesque, 1820)
- Andropogon virginicus L.
- Arthurdendyus triangulatus (Dendy, 1895)
- Asclepias syriaca L.
- Asterias amurensis Lutken, 1871
- Axis axis (Erxleben, 1777)

- Baccharis halimifolia L.
- Bipalium kewense Moseley, 1878
- Branta canadensis (Linnaeus, 1758)
- Broussonetia papyrifera (L.) L'Hér. ex Vent.
- Cabomba caroliniana A.Gray
- Callinectes sapidus Rathbun, 1896
- Callosciurus erythraeus (Pallas, 1779)
- Callosciurus finlaysonii (Horsfield, 1823)
- Cardiospermum grandiflorum Sw.
- Castor canadensis Kuhl, 1820
- Celastrus orbiculatus Thunb.
- Cenchrus setaceus (Forssk.) Morrone
- Cervus nippon Temminck, 1838
- Channa argus (Cantor, 1842)
- Cherax destructor Clark, 1936
- Cherax quadricarinatus (von Martens, 1868)
- Cipangopaludina chinensis (J.E.Gray, 1833)
- Cortaderia jubata (Lemoine) Stapf
- Cortaderia selloana (Schult. & Schult.f.) Asch. & Graebn.
- Corvus splendens Vieillot, 1817
- Crassula helmsii (Kirk) Cockayne
- Delairea odorata Lem.
- Ehrharta calycina Sm.
- Elodea nuttallii (Planch.) H.St.John
- Eriocheir sinensis H.Milne Edwards, 1853
- Faxonius immunis (Hagen, 1870)
- Faxonius limosus (Rafinesque, 1817)
- Faxonius rusticus (Girard, 1852)
- Faxonius virilis (Hagen, 1870)
- Fundulus heteroclitus (Linnaeus, 1766)
- Gambusia affinis (Baird & Girard, 1853)
- Gambusia holbrooki Girard, 1859
- Gunnera tinctoria (Molina) Mirb.
- Gymnocoronis spilanthoides DC.
- Hakea sericea Schrad. & J.C.Wendl.
- Heracleum mantegazzianum Sommier & Levier
- Heracleum persicum Desf.
- Heracleum sosnowskyi Manden.
- Herpestes javanicus (É.Geoffroy Saint-Hilaire, 1818)
- Humulus scandens (Lour.) Merr.
- Hydrocotyle ranunculoides L.fil.
- Impatiens glandulifera Royle
- Koenigia polystachya (Wall. ex Meisn.) T.M.Schust. & Reveal
- Lagarosiphon major (Ridl.) Moss
- Lampropeltis getula (Linnaeus, 1766)
- Lepomis gibbosus (Linnaeus, 1758)
- Lespedeza cuneata (Dum.Cours.) G.Don
- Limnoperna fortunei (Dunker, 1857)
- Lithobates catesbeianus (Shaw, 1802)
- Ludwigia grandiflora (Michx.) Greuter & Burdet
- Ludwigia peploides (Kunth) P.H.Raven
- Lygodium japonicum (Thunb.) Sw.

- Lysichiton americanus Hultén & H.St.John
- Marisa cornuarietis (Linnaeus, 1758)
- Microstegium vimineum (Trin.) A.Camus
- Misgurnus anguillicaudatus (Cantor, 1842)
- Misgurnus mohoity (Dybowski, 1869)
- Morone americana (Gmelin, 1789)
- Mulinia lateralis (Say, 1822)
- Muntiacus reevesi (Ogilby, 1839)
- Mustela vison Schreber, 1777
- Myiopsitta monachus (Boddaert, 1783)
- Myocastor coypus (Molina, 1782)
- Myriophyllum aquaticum (Vell.) Verdc.
- Myriophyllum heterophyllum Michx.
- Nasua nasua (Linnaeus, 1766)
- Nyctereutes procyonoides (Gray, 1834)
- Obama nungara Carbayo, Alvarez-Presas, Jones & Riutort, 2016
- Ondatra zibethicus (Linnaeus, 1766)
- Oxyura jamaicensis (J.F.Gmelin, 1789)
- Pachycondyla chinensis (Emery, 1895)
- Pacifastacus leniusculus (Dana, 1852)
- Parthenium hysterophorus L.
- Perccottus glenii Dybowski, 1877
- Persicaria perfoliata (L.) H.Gross
- Pistia stratiotes L.
- Platydemus manokwari Beauchamp, 1962
- Plotosus lineatus (Thunberg, 1787)
- Pontederia crassipes Mart.
- Procambarus clarkii (Girard, 1852)
- Procambarus virginalis Lyko, 2017
- Procyon lotor (Linnaeus, 1758)
- Prosopis juliflora (Sw.) DC.
- Pseudorasbora parva (Temminck & Schlegel, 1846)
- Pueraria montana (Lour.) Merr.
- Pycnonotus cafer (Linnaeus, 1766)
- Pycnonotus jocosus (Linnaeus, 1758)
- Reynoutria japonica Houtt., Reynoutria sachalinensis (F.Schmidt) Nakai, Reynoutria ×bohemica Chrtek & Chrtková
- Rugulopteryx okamurae (E.Y.Dawson) I.K.Hwang, W.J.Lee & H.S.Kim, 2009
- Salvinia ×molesta D.S.Mitch.
- Sciurus carolinensis Gmelin, 1788
- Sciurus niger Linnaeus, 1758
- Solenopsis geminata (Fabricius, 1804)
- Solenopsis invicta Buren, 1972
- Solenopsis richteri Forel, 1909
- Tamias sibiricus (Laxmann, 1769)
- Threskiornis aethiopicus (Latham, 1790)
- Trachemys scripta (Thunberg In Schoepff, 1792)
- Tradescantia fluminensis Vell.
- Triadica sebifera (L.) Small
- Vespa mandarinia Smith, 1852
- Vespa velutina nigrithorax Buysson, 1905
- Wasmannia auropunctata (Roger, 1863)

- Xenopus laevis (Daudin, 1802)
- Zostera japonica Asch. & Graebn.

B EXPERT SURVEY RESULTS

B.1 ADDITIONAL DESCRIPTIVE RESULTS

B.1.1 Invasion stage PrIUS against survey

Figure B.1 displays the invasion stage as assigned in the PrIUS report (D'hondt *et al.*, 2022) against the invasion stage as reported in the expert survey. Species for which discrepancies occur are highlighted.

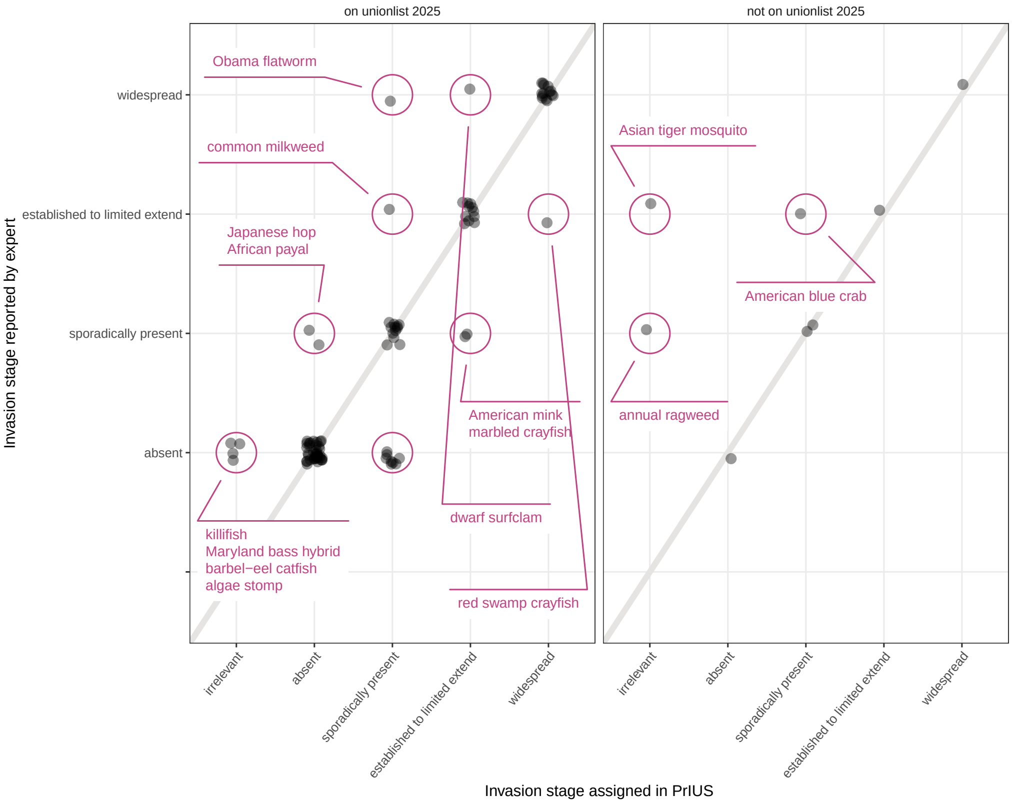

Figure B.1: Invasion stage according to PrIUS and the expert survey

B.1.2 Response proportions “unknown / I do not know”

Figure B.2 shows the proportion of responses that fall into the category “unknown / I do not know” across all questions per species. As in Figure 4.1, species are sorted according to their overall urgency scores nested within their overall feasibility scores.

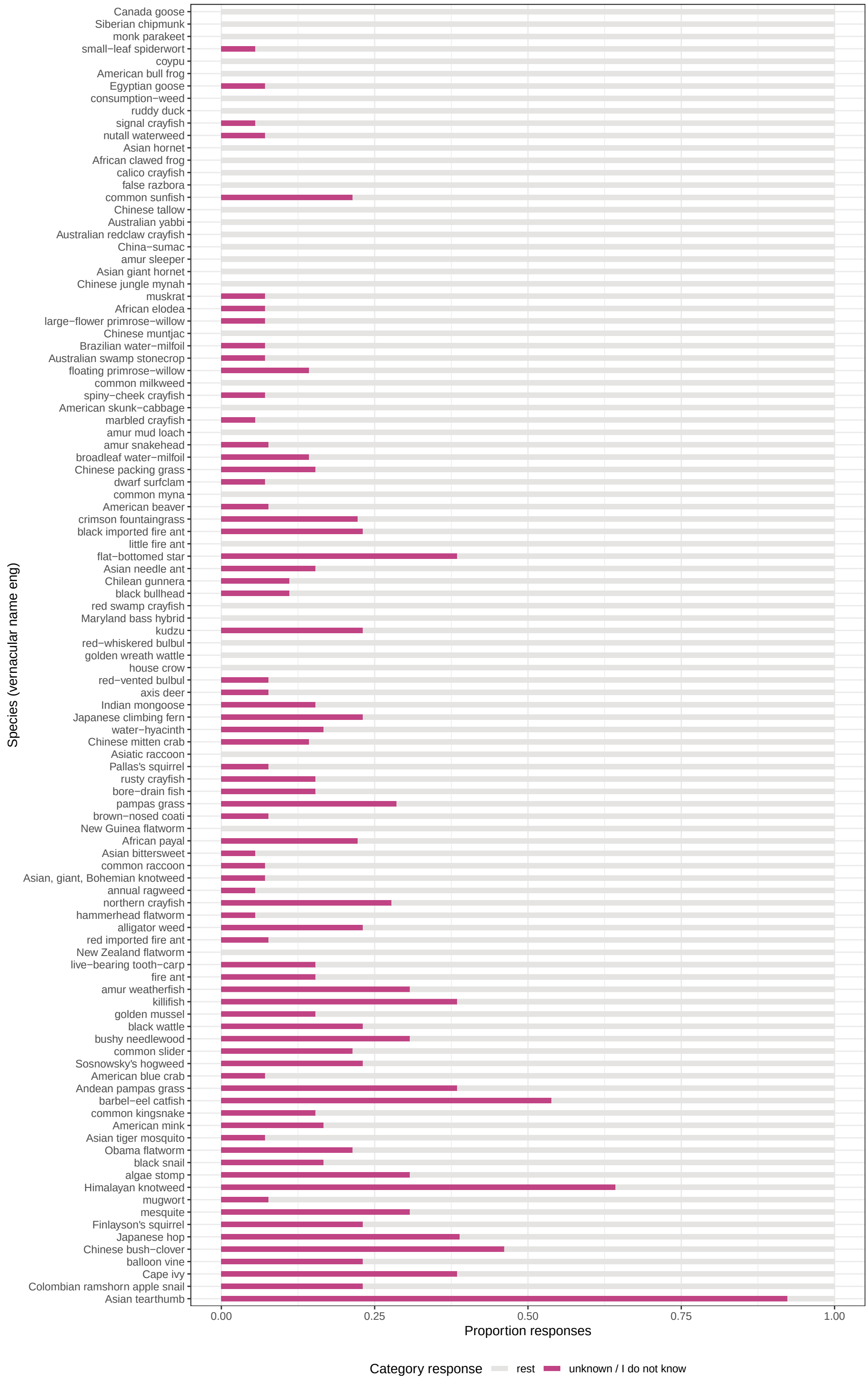

Figure B.2: Relative proportions of responses ‘unknown / I do not know’ per species

Figure B.3 shows the proportion of responses that fall into the category “unknown / I do not know” across all species per question.

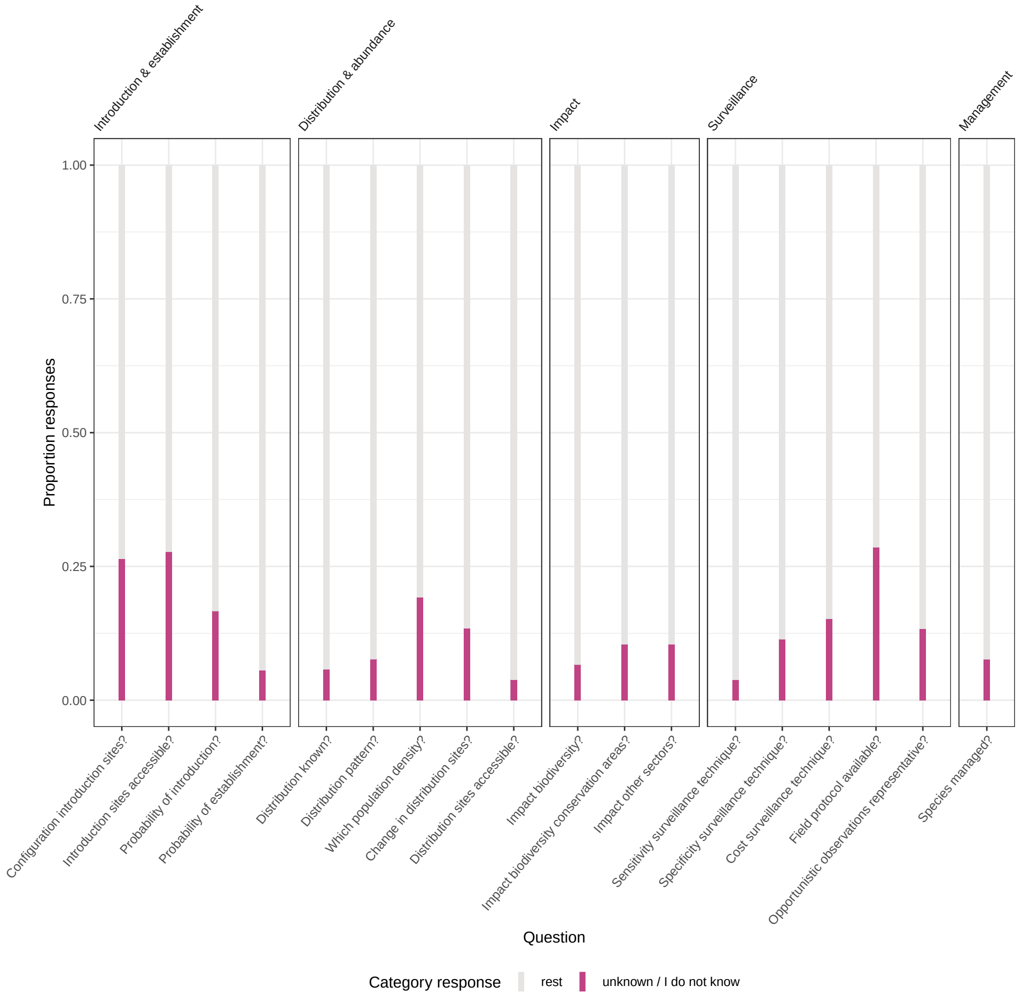

Figure B.3: Relative proportions of responses ‘unknown / I do not know’ per question

Figure B.4, finally, shows the proportion of responses that fall into the category "unknown / I do not know" per question and per species. Species are sorted according to their overall urgency scores nested within their overall feasibility scores.

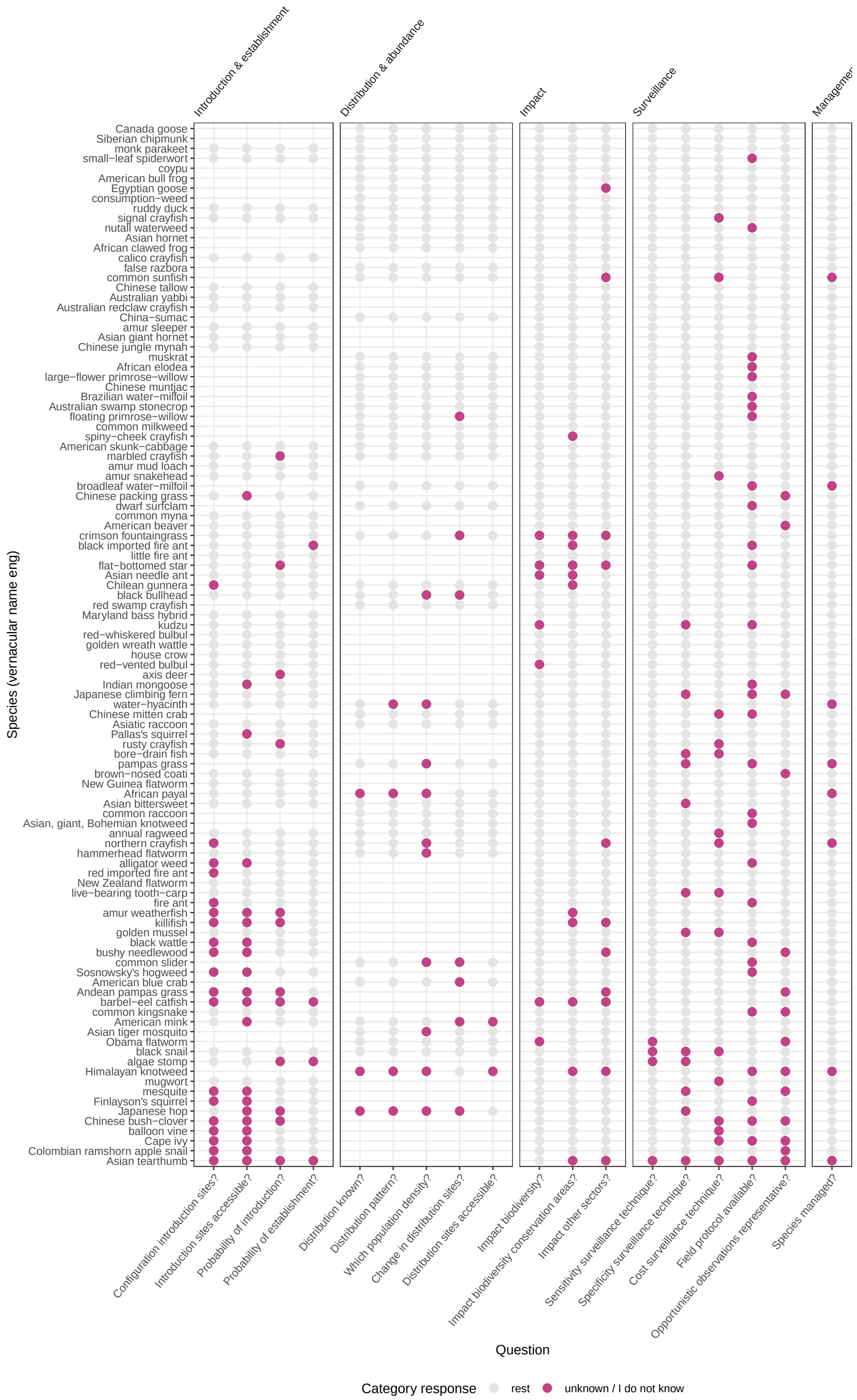

Figure B.4: Pattern of responses 'unknown / I do not know' per species and question

 10.21436/inbor.133486163

B.1.3 Monitoring methods

Figure B.5 displays the monitoring methods reported in the survey sorted by frequency. Note that per species multiple methods could be reported, via multiple-choice and open questions. The fact that two question formats were used leads to partly overlapping methods (e.g., while a number of specific traps were included in the multiple choice options, some experts responded "traps" to the open question). Methods are post-hoc grouped into broader categories distinguished by colour.

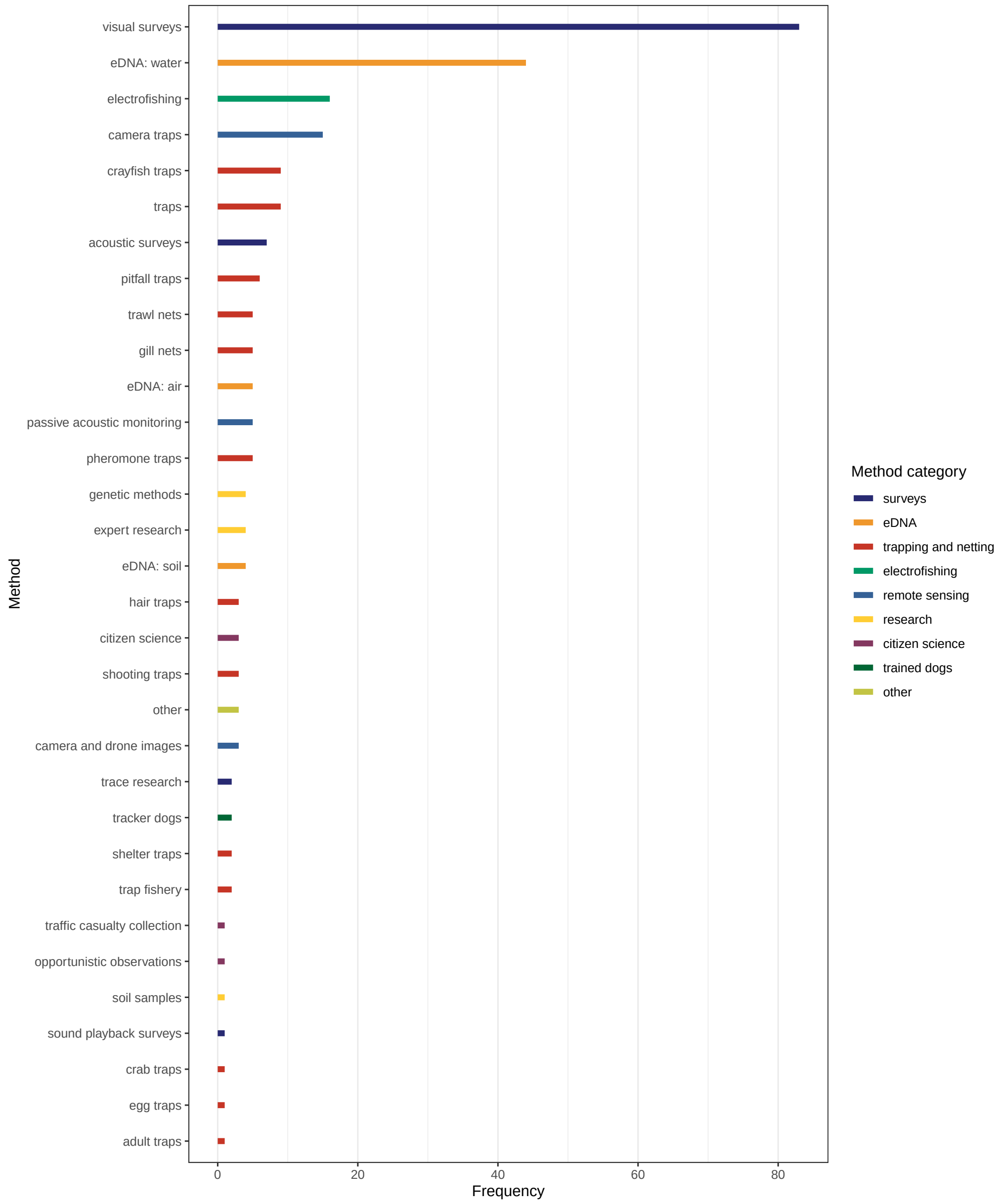

Figure B.5: Absolute frequencies of monitoring methods reported

Figure B.6 shows all pairwise combinations of monitoring methods reported in the survey sorted by frequency.

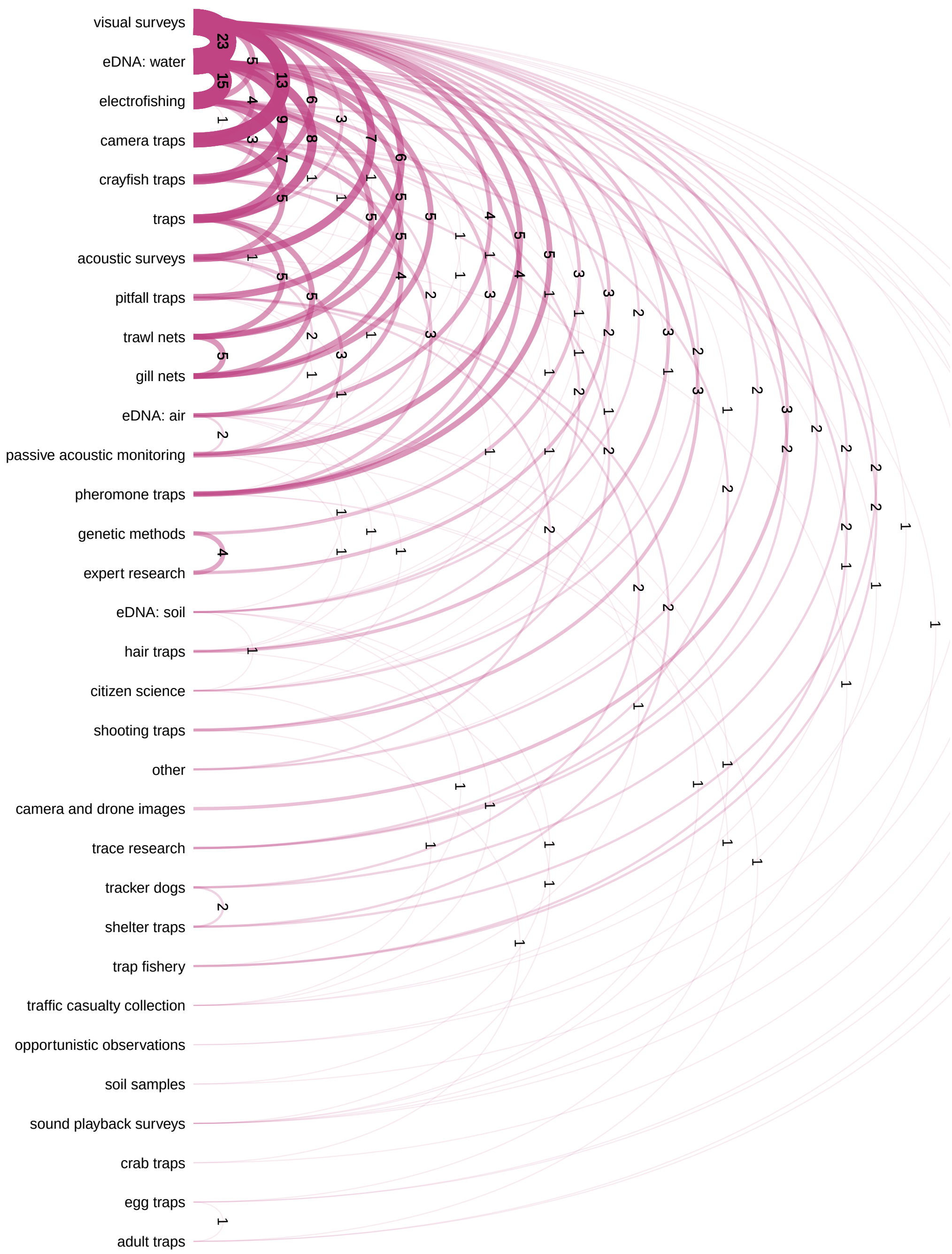

Figure B.6: Absolute frequencies of pairwise combinations of monitoring methods reported

10.21436/inbor.133486163

B.1.4 Existing monitoring efforts

Figure B.7 provides an overview over existing monitoring efforts reported per species. Monitoring efforts are sorted by the number of species they cover (highest coverage left). Species are grouped by kingdom, and within groups sorted according to their overall urgency scores nested within their overall feasibility scores.

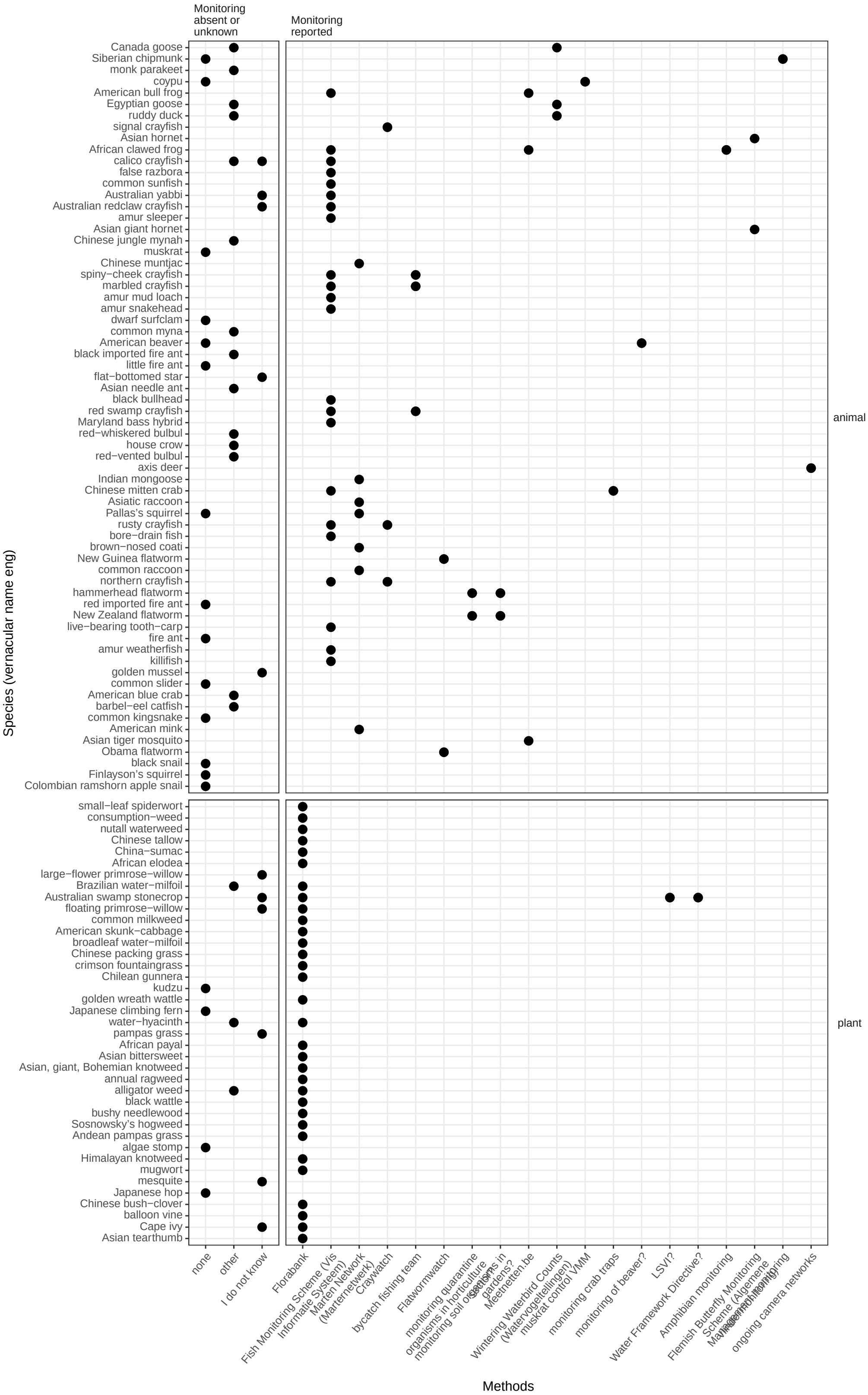

Figure B.7: Existing monitoring efforts reported per species

C R AND R PACKAGE INFORMATION

For the current project, we use the R package renv (Ushey & Wickham, 2024) for dependency management. The following information is thus extracted from the current version (date: 2025-12-10) of the *renv.lock* file in the github repository inbo/mias-general (Adolf, s.d.) accompanying this project. The *renv.lock* file (and its commit history) provides detailed information on the R version and all R packages used.

C.1 R VERSION USED

We have used R version 4.4.3 (R Core Team, 2025).

C.2 QUARTO VERSION USED

We have used Quarto version 1.6.42 (Allaire *et al.*, 2025).

C.3 PRIMARY R PACKAGES

As primary R packages, we define those R packages that we directly call in the project's source code. These are (from most to least frequently used):

- dplyr (version 1.1.4, Wickham *et al.*, 2023a)
- ggplot2 (version 3.5.1, Wickham *et al.*, 2024a)
- kableExtra (version 1.4.0, Zhu, 2024)
- googledrive (version 2.1.1, McGowan & Bryan, 2023)
- tidyselect (version 1.2.1, Henry & Wickham, 2024)
- tidyr (version 1.3.1, Wickham *et al.*, 2024b)
- googlesheets4 (version 1.1.1, Bryan, 2023)
- knitr (version 1.47, Xie, 2024)
- stringr (version 1.5.1, Wickham, 2023a)
- INBOtheme (version 0.6.0, Onkelinx, 2024)
- purrr (version 1.0.2, Wickham & Henry, 2023)
- assertthat (version 0.2.1, Wickham, 2019)
- quarto (version 1.4.4, Allaire & Dervieux, 2024)
- INBOmd (version 0.6.4, Onkelinx, 2023)
- tibble (version 3.2.1, Müller & Wickham, 2023)
- ggraph (version 2.2.1, Pedersen, 2024a)
- rgbif (version 3.8.1, Chamberlain *et al.*, 2024)
- tidygraph (version 1.3.1, Pedersen, 2024b)
- generics (version 0.1.3, Wickham *et al.*, 2022)
- ggtext (version 0.1.2, Wilke & Wiernik, 2022)
- rmarkdown (version 2.27, Allaire *et al.*, 2024)
- trackdown (version 1.5.1, Kothe *et al.*, 2025)
- vctrs (version 0.6.5, Wickham *et al.*, 2023b)
- waldo (version 0.5.2, Wickham, 2023b)
- withr (version 3.0.0, Hester *et al.*, 2024)
- bib2df (version 1.1.2.0, Ottolinger, 2024)

- ggforce (version 0.4.2, Pedersen, 2024c)
- glue (version 1.7.0, Hester & Bryan, 2024)
- magrittr (version 2.0.3, Bache & Wickham, 2022)

C.4 NON-PRIMARY R PACKAGES

The following list contains all additional, non-primary packages in alphabetical order:

- abind (version 1.4-5)
- askpass (version 1.2.0)
- assertable (version 0.2.8)
- backports (version 1.5.0)
- base64enc (version 0.1-3)
- bit (version 4.0.5)
- bit64 (version 4.0.5)
- blob (version 1.2.4)
- boot (version 1.3-31)
- brew (version 1.0-10)
- brio (version 1.1.5)
- broom (version 1.0.6)
- bslib (version 0.7.0)
- cachem (version 1.1.0)
- callr (version 3.7.6)
- car (version 3.1-2)
- carData (version 3.0-5)
- cellranger (version 1.1.0)
- checklist (version 0.4.2)
- class (version 7.3-23)
- classInt (version 0.4-10)
- cli (version 3.6.3)
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