M6 First GRIIS checklist updated

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Table of contents

Summary

Task 4.2 of the OneSTOP project aims to generate updated national Global Register of Introduced and Invasive Species (GRIIS) checklists, with a focus on Cyprus, Belgium, Portugal and Romania. As a first milestone, the Belgian checklist (GRIIS Belgium) was updated and republished. Originally released in 2019 within the TriAS project, GRIIS Belgium integrates twelve authoritative source checklists that are standardized and published as open and FAIR datasets on GBIF. The checklist is generated through a transparent, semi-automated and repeatable workflow.

To enable the update, the data publication workflows of the contributing source checklists were reviewed and, where possible, revised. This included adding newly recorded taxa, migrating raw data to a standardized Google Spreadsheet template, incorporating newly introduced Darwin Core terms, and republishing the standardized datasets to GBIF. Some checklists could only be partially updated due to limited maintenance or external data governance. Subsequently, GRIIS Belgium was regenerated using an adapted workflow that overcomes current limitations of the GBIF Species API in handling the new Darwin Core terms. These improvements allowed the successful republication of GRIIS Belgium. Future work (2026–2027) will further enhance the checklist through the addition of new thematic datasets, improved source data management, and the resolution of remaining technical issues.

List of abbreviations

API	Application Programming Interface
EU	European Union
GBIF	Global Biodiversity Information Facility
GRIIS	Global Register for Introduced and Invasive Species
IPT	Integrated Publication Toolkit

1. Introduction

The objective of Task 4.2 in the OneSTOP project is to “generate new and updated national Global Register of Introduced and Invasive Species (GRIIS) checklists (…)”. This task focuses on the national checklists of four countries: Cyprus, Belgium, Portugal and Romania. The first checklist to be updated is GRIIS Belgium (https://doi.org/10.15468/xoidmd), which was first published in 2019 as part of the TriAS project (Tracking Invasive Alien Species, Vanderhoeven et al. 2017).

GRIIS Belgium is compiled by integrating twelve authoritative checklists (table 1), each defined by a specific taxonomic, geographic or thematic scope. Each source checklist is made interoperable by aligning it with the Darwin Core standard, an international standard for biodiversity observation data (Wieczorick et al. 2012). For this process of data standardization, we use a repeatable workflow openly documented on GitHub. Each dataset is then published as an open datasets to the Global Biodiversity Information Facility (GBIF). Once published, these checklists are matched against the GBIF Backbone Taxonomy (GBIF Secretariat, 2025) and are thus standardized by scientific names. GRIIS Belgium is generated through a semi-automated, transparent and repeatable process by harvesting these interoperable checklists via the GBIF Species Application Programming Interface (API). The complete workflow for compiling GRIIS Belgium is documented at https://trias-project.github.io/unified-checklist/

This semi-automated and repeatable workflow substantially enhanced the findability, accessibility, interoperability and reusability of introduced and invasive species data in Belgium, in line with the FAIR principles (findable, accessible, interoperable and reusable, Wilkinson et al. 2016). However, the most recent major update of GRIIS Belgium dates back to September 2023 (Desmet et al. 2023). The update and republication of GRIIS Belgium is an important milestone within the OneSTOP project. Achieving this milestone required a revision of the entire workflow, from the management and publication of the source data (Chapter 2) to the generation of the GRIIS Belgium checklist (Chapter 3).

2. Update the authoritative source checklists

Each source checklist contributing to GRIIS Belgium is published as an independent dataset on GBIF (table 1). The data publication workflow integrates (1) an initial raw data cleaning step, (2) an R-based processing step to transform and standardize the raw data to Darwin Core, and (3) the subsequent publication of the standardized datasets to GBIF. The first source dataset using this workflow was published in 2017 (Verloove et al. 2017), while the most recent dataset was published in 2022 (Swinnen et al. 2022). Over this five-year period, several significant changes were implemented in the data publication workflow:

- Development of the “checklist recipe” (Reyserhove et al. 2018), a ready-to-use toolbox designed to enable taxonomic experts to maintain and regularly publish checklist data on GBIF. Central to this approach is a template Google Spreadsheet used to manage raw data. The template provides guidelines on best practices for raw data management, includes dropdown menus wherever possible and closely aligns to the structure of the interoperable Darwin Core Archives. By adopting this template to manage the raw data, the number of data cleaning steps in the data publication workflow is significantly reduced, making the it more streamlined.

- Recent updates of the Darwin Core standard. This international standard for biodiversity observation data (Wieczorick et al. 2012) was adapted to better fit the sharing of IIS information, introducing new terms related to the pathway of introduction, degree of establishment and native status (Groom et al. 2019).

To achieve this milestone, we revised the data publication process for several of the source checklists underlying GRIIS Belgium. Where applicable, this included (1) updating the checklists with newly recorded taxa, (2) migrating the raw data to the standardized Google Spreadsheet template, (3) updating the standardization workflow to integrate the new Darwin Core terms, and (4) republishing the standardized datasets to GBIF (Table 1). For some source checklists, it was not possible to update all components of the workflow, for the following reasons:

- the workflow for the checklist of rust fungi and the RINSE checklist was not updated. These lists haven't been updated since their first publication and are not actively maintained.
- the workflow for the manual of alien plants will be revised in 2026, with a special focus on improved management of the raw dataset
- both the WRiMS and Waarnemingen.be/Observations.be checklists are extensively managed and regularly updated by external organisations. Information on the pathway of introduction and degree of establishment (the new Darwin Core terms) is not included in the publication to GBIF.

3. Update GRIIS Belgium

After updating the publication workflow for each individual checklist, we needed to regenerate the GRIIS Belgium dataset. This regeneration is done through a semi-automated process by rerunning the script available at: https://trias-project.github.io/unified-checklist/

One of the first steps in this process is retrieving data from GBIF via the Species API, specifically the Darwin Core Taxon Core (including all taxa) and the related Distribution Extension (containing distribution information for these taxa) for each checklist. However, the GBIF Species API does not include the new Darwin Core terms `degreeOfEstablishment` and `pathway`. These changes caused issues when rerunning the script to update GRIIS Belgium, as documented here in these Github issues: https://github.com/gbif/checklistbank/issues/306 and https://github.com/trias-project/unified-checklist/issues/92. To allow a republication of the list, we needed to accommodate for this problem. In short, we accessed information related to the new terms as verbatim records using the GBIF Species API. This addition to the script allowed us to retrieve the information required for the update of GRIIS Belgium. The changes to the workflow are described in this GitHub pull request: https://github.com/trias-project/unified-checklist/pull/94
These updated files were uploaded to the INBO IPT and harvested by GBIF, triggering a new update of GRIIS Belgium on 29th of December, 2025.

4. Future updates for GRIIS Belgium

In 2026-2027, we plan several updates to further improve GRIIS Belgium:

- Add several new thematic checklists, such as a checklist on alien ants and Agaricales
- Improve source data management for the Manual of Alien Plants
- Resolve outstanding issues reported here: https://github.com/trias-project/unified-checklist/issues

Table 1: Updates of the data publication workflow for each of the source checklists. Updates involve: improved data management using template (including link), addition of new taxa (+ year of last update), inclusion of the new Darwin Core terms degreeOfEstablishment and pathway, and date + link to last publication to GBIF.

Dataset name	Source data			Data standardization	Data publication	
	Link	update taxa	new template	new terms	DOI	date last republication
The Manual of Alien Plants, Belgium	Link	yes (2024)	no	yes	10.15468/wtda1m	2025-12-17
Checklist of Alien birds of Belgium	Link	yes (2025)	Yes	yes	10.15468/wr3gis	2025-12-16
Checklist of non-native fishes in Flanders, Belgium	Link	yes (2024)	Yes	yes	10.15468/xvuzfh	2024-07-23
Checklist of alien herpetofauna of Belgium	Link	yes (2024)	Yes	yes	10.15468/pnxu4c	2024-09-02
Inventory of alien macroinvertebrates in Flanders, Belgium	Link	yes (2024)	Yes	yes	10.15468/yxcq07	2025-12-16
Registry of introduced terrestrial molluscs in Belgium	Link	yes (2024)	Yes	yes	10.15468/t13kwo	2025-12-19
Checklist of alien species in the Scheldt estuary in Flanders, Belgium	Link	yes (2025)	Yes	yes	10.15468/8zq9s4	2025-12-17

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Catalogue of the rust fungi of Belgium	Link	No	No	No	10.15468/2dboyn	2019-03-19
World Register of Introduced Marine Species (WRiMS)		yes (2025)	No	No	10.14284/347	2025-12-02
Waarnemingen.be/observations.be – List of species observed in Belgium	Link	yes (2025)	No	No	10.15468/a7wkuh	2025-04-11
Ad hoc checklist of alien species in Belgium	Link	yes (2025)	Yes	Yes	10.15468/3pmlxs	2025-09-23
RINSE – Pathways and vectors of biological invasions in Northwest Europe		No	no	No	10.15468/guejza	2021-05-11

5. References

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Verloove, F., Groom, Q., Brosens, D. et al. (2017) Manual of the Alien Plants of Belgium. Version 1.1. Meise Botanic Garden. Checklist dataset https://doi.org/10.15468/wtda1m

Wieczorick, J., Bloom, D., Guralnick, R. et al. (2012). Darwin Core: an evolving community-developed biodiversity standard. PLOS One. https://doi.org/10.1371/journal.pone.0029715

Wilkinson, M.D., Dumortier, M., Aalbersberg et al. (2016) The FAIR guiding principles for scientific data management and stewardship. Scientific Data 3: 160018. https://doi.org/10.15468/a7wkuh

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