BioInvasiones

Bioinvasiones (1) 2026

Original Research

Updating the Invasive Alien Species List: A Novel Process for Brazil's Federal Protected Areas

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Special issue: Lists of alien taxa in the Caribbean and Latin America: current status and proposed solutions

Abstract: TUpdating the Invasive Alien Species (IAS) list in Federal Protected Areas (FPA) is vital for biodiversity conservation. In Brazil, ICMBio has worked continuously on this process in recent years, albeit without standardization. This paper introduces a new process for updating the IAS list in Brazil's FPA. The workflow development involved a three-day participatory workshop for process mapping, following the Results-Based Management Program approach. Subsequently, a workshop with 26 participants was held to discuss bottlenecks, challenges, and alternatives for the update. The resulting workflow consists of three main phases: consultation, data analysis, and consolidation. During the update, data were collected from reports and databases. The reliability of the information is then verified, ensuring the species is not native to the protected area and its impacts are recognized. In doubtful cases, records were validated for specialists. Additionally, the procedure includes five key evaluative indicators to monitor and assess its effectiveness. In the first cycle, we received a higher number of reports (n=60,306) of IAS affecting FPA, with data gathered from multiple sources. Several specialists and volunteers contributed to validation. We identified IAS of flora (n=162) and fauna (n=128) across 246 of 340 FPA. The new workflow ensures data standardization and reliability, fostering integration across sectors and institutions. Furthermore, the established workflow and the resulting list were formally recognized through the publication of a federal government regulation. Institutionalizing the process and public consultation periods enhance participation, supporting improved IAS management and effective strategies for addressing biological invasions.

Key-words: biodiversity conservation, biological invasions, ecological impact, IAS, management strategies, non-indigenous species and workflow.

Introduction

Invasive alien species (IAS) are among the primary direct drivers of biodiversity loss globally, posing serious threats not only to native ecosystems and species but also to human health, economic stability, livelihoods, and food security (Ielmini & Sankaran 2021; Haines et al.2024). Numerous studies have documented the significant impacts of IAS on threatened and endangered species, highlighting a common challenge faced by countries worldwide and reinforcing the urgency of implementing effective strategies for prevention, early detection, and management (Duenas et al.2021; Haines et al.2024).

In Brazil, research has shown that IAS represent one of the most pressing environmental threats to biodiversity. These species can cause long-lasting ecosystem alterations, reduce native populations, and disrupt ecological processes (Guimarães & Schmidt 2017; Marangon et al.2023). Consequently, controlling IAS has become a critical priority in protected areas, as both their ecological (Sampaio & Schmidt 2013) and economic impacts (Zenni et al.2021) are well documented.

Since 2011, the Chico Mendes Institute for Biodiversity Conservation (ICMBio) has held the institutional mandate to coordinate the management of IAS within Brazil's federal protected areas (FPA) (Brasil 2011). In this context, the Coordination of Invasive Alien Species Management (CMEEI) was created to provide technical support for decision-making and foster inter-institutional collaboration. CMEEI leads national efforts to tackle biological invasions in both aquatic and terrestrial environments, across multiple taxonomic groups of fauna and flora.

The first systematic survey of IAS records in Brazilian FPA was conducted in 2013, using data from management plans, Rapid Assessment and Prioritization of Protected Areas Management (RAPPAM) reports, and information provided by some FPA managers (Sampaio & Schmidt 2013). Subsequently, a targeted effort was undertaken to compile records of invasive alien fauna, expanding the preliminary list through consultation of multiple sources, including: (i) management plans and RAPPAM reports; (ii) the I3N database maintained by the non-governmental organization Instituto Horus; (iii) scientific literature; and (iv) responses to questionnaires applied to managers of all FPA created so far. For inclusion in this list, species were classified as alien and invasive according to the following criteria: (i) non-native status, requiring confirmation of the species' natural distribution outside the FPA's region, and (2) invasive status, demonstrated through documented evidence of biodiversity impacts anywhere in the world, verified by at least one of the following: bibliographic references, recognized databases (I3N Brazil, Global Invasive Species Database - GISD/ISSG, and CABI Compendium), or official state IAS lists (Guimarães 2015). It should be noted that at the time (and to the present date), Brazil lacked an official national IAS list. Therefore, validation of a species as an invasive alien for inclusion in the list required rigorous analysis of both its natural distribution and evidence of impacts on biodiversity. These criteria were maintained in the list updates through 2023, as detailed in the following sections. The consolidated survey data enabled ICMBio to compile and maintain an IAS list in FPA, although it was unofficial, as it had not been ratified by regulatory act. While periodically updated through inputs from FPA managers, many records experienced delayed incorporation due to the rigorous analysis and validation procedures required, which exceeded the operational capacity of the technical team.

In 2019, the update initiative integrated both the accumulated unvalidated records and new data from post-2013 management plans, and from two

ICMBio systems: the Management Analysis and Monitoring System (SAMGE) - a tool for assessing FPA management effectiveness, and the Biodiversity Authorization and Information System (SISBIO) - the platform for requesting and issuing research permits in FPA.

The following year prioritized analyzing fish records, the animal group with both the highest number of IAS occurrences and the greatest uncertainty regarding species identification and native distribution. This challenge was exacerbated by the fact that most cases involved native species translocated between distinct Brazilian hydrographic basins – a scenario requiring particularly meticulous analysis due to the fine-scale biogeographic delineations needed. These difficulties stem from Brazil's exceptional diversity of native fish species and the complex distribution patterns across distinct hydrographic basins. To ensure data reliability, all records underwent rigorous evaluation, with technical validation conducted by two ICMBio's National Research and Conservation Centers (CNPC) specialized in fish from continental waters.

From that point until 2023, record analysis for list inclusion was conducted non-systematically, relying on spontaneously received information from multiple unstandardized sources especially through contact with managers and researchers, by email and administrative processes. The high frequency of data submissions coupled with the absence of a structured protocol for data collection and analysis resulted in accumulating unprocessed records that were consequently not incorporated into the list. While this initial effort represented significant progress, it revealed the critical need to improve reception, validation, and management mechanisms for IAS occurrence data in FPA to enhance both process efficiency and data reliability. Improving this list is an ongoing challenge that requires periodic review and updates. The lack of standardization in receiving this data greatly hindered and compromised the process of analysis and validation, creating an additional workload for the team and requiring consultation with multiple studies, experts, databases, and documents.

The development and periodic updating of the IAS list in FPA are essential to support ICMBio in enhancing data quality and decision-making, enabling the implementation of more precise and effective management actions. Since 2023, CMEEI has prioritized this process as part of ICMBio's legal mandate and institutional responsibility for managing invasive alien species within the FPA system. Although the focus on FPA reflects this administrative jurisdiction, we acknowledge that biological invasions transcend political boundaries and operate across broader ecological gradients. Therefore, the standardized and validated list developed for FPA also serves as a technical reference that can inform complementary lists and analyses at wider territorial and ecological scales — such as ecosystems, ecoregions, or hydrographic basins — under the jurisdiction of other institutions, including the Ministry of the Environment and Climate Change, which coordinates the development of the national IAS list. Moreover, the institutionalization of the list and its supporting instruments enables protected area managers to make context-specific decisions and define local priorities while considering the ecological complexity and the pathways and vectors of introduction operating at larger scales. In this way, the FPA-focused list fulfills ICMBio's federal mandate and simultaneously contributes to multi-scale, integrative strategies for addressing biological invasions across Brazil.

This manuscript will present the efforts that led to the development of protocols and workflows started in 2023 and implemented in 2024, as well as present the results of the IAS list in FPA published in February 2025.

Materials and Methods

Development of the new workflow

To standardize and optimize the process for updating the IAS list in Brazilian FPA, a participatory workshop was conducted in December 2023. To support this effort, we mapped and systematized the update process using a modeling methodology aligned with the Results-Based Management Program (PGR) approach, guided by the principles outlined in the Guide to Business Process Management – Common Body of Knowledge (ABPM 2009).

Initially, the ICMBio PGR team led the process modeling. Concurrently, CMEEI compiled essential reference materials to support workshop planning, including: a preliminary "TO-BE" workflow diagram created in Visio®; a spreadsheet outlining proposed requirements for IAS records in FPA, detailing necessary information and validation steps; a logical framework proposal; and a proposed workshop agenda involving key stakeholders.

To supplement these preparatory materials, additional data was collected through planning meetings and a Process Modeling Request Form developed by PGR. This questionnaire was distributed to identify bottlenecks in the process. Using this information, an AS-IS process map was developed. Additionally, the TO-BE map was also created using Bizagi® software, generating version 1 of the workflow to be discussed during the workshop. The AS-IS model was analyzed using the "8 Triggers" included in the form. This method assesses process efficiency through key indicators:

1. Process Outcome Analysis – Evaluating improvements in time, capacity, and quality.

2. Process Variability Analysis – Ensuring low process variability.

3. Bottleneck Identification – Assessing delays across different instances.

4. Handoff Analysis – Optimizing transitions between sectors.

5. Human Interaction Analysis – Evaluating skill-related challenges among stakeholders.

6. External Interaction Analysis – Assessing engagement with external entities.

7. Business Rule Analysis – Identifying excessive or missing regulations.

8. Gap Analysis – Detecting missing procedures, inefficiencies, and resistance points.

Subsequently, to develop a structured and efficient workflow for updating the IAS list in FPA, a three-day workshop was held, involving discussions on update stages, timelines, institutional roles, monitoring indicators, data requirements for reports, and contributions toward process standardization. The event included 26 participants representing 18 different organizational sectors within ICMBio, including protected area managers.

The workshop began with an overview of biological invasions concepts and ICMBio's management strategies to align participants' understanding. This introduction was followed by presentations on the

existing procedures, the need for a unified workflow, and collaborative discussions addressing each stage of the proposed model. Insights from the process mapping exercises informed subsequent sessions dedicated to data needs and regulatory frameworks. The methodology employed a process mapping approach, comparing two updating flows: "AS-IS" (previous workflow) and "TO-BE" (optimized model developed collectively during the workshop). By the end of the workshop, a standardized schedule for updates had been established, including mechanisms for periodic evaluations, revisions, and validations to support the long-term effectiveness of the new system.

Results

The workflow established during the participatory workshop outlined steps to overcome the main bottlenecks of a process that was previously carried out without a defined periodicity, clear structure, shared responsibilities, or formal institutional regulation. The new workflow for updating the IAS list consists of three main phases: (1) Consultation, (2) Data analysis, and (3) Consolidation (Figure 1).

Phase 1: Consultation

To initiate the update cycle, a new electronic process was opened to request IAS occurrence records in FPA from both internal and external databases. Data sources included IAS occurrence records from established databases and previously reported records outside the consultation period within online forms.

The public IAS consultation commenced with the launch of an online form, allowing individuals to submit their records. The form remained open for one month, during which additional data was collected through broad and targeted consultations. The broad consultation sought input from research institutions, conservation partners, and the public, while the targeted consultation focused on ICMBio personnel, including temporary agents, fellows, and interns. Records submitted outside the consultation period were stored in a repository for consideration in the next update cycle.

Phase 2: Data analysis

Following data collection, each record underwent an initial screening to determine whether it represented a new or previously recorded occurrence of IAS. If the species was already present in the current list, its occurrence was updated without further validation. For new records, the following steps were undertaken:

1. Verification against the national IAS list: The presence of the newly reported species was checked against the unpublished national IAS list. If absent, specialists from ICMBio's National Research and Conservation Centers (CNPC) were consulted to assess its invasive status, origin, and impact. Because assessing the impacts of biological invasions is complex and absence of evidence is not evidence of absence (Blackburn et al.2011; IPBES 2023), the list includes both IAS with confirmed local impacts and non-native species with documented invasion histories and impacts elsewhere, reflecting their potential threat and the need for precautionary action.

2. Data reliability and species identification: The reliability of the data was evaluated by verifying photographic evidence or scientific publications supporting the record. This step addressed frequent misidentifications in reported occurrences, ensuring data accuracy and validity.

3. Confirmation of species' original distribution: It was confirmed whether the species was within its original distribution range. Particular attention was given to distinguishing between species native to Brazil but invasive outside their natural range. In cases of uncertainty regarding the species' original distribution and impact, records were forwarded to specialists.

4. Unknown or questionable records were reviewed by the CNPC based on species-specific criteria for expert validation, classification, and impact assessment. Specialists from CNPC had a three-month period to analyze the records and return validated categorizations.

Phase 3: Consolidation

In the final stage, validated IAS records were integrated with those from previous cycles to ensure consistency and eliminate duplicates. Quantitative analyses were conducted to assess the total number of IAS, the taxonomic groups represented, and the number of FPA impacted. The consolidated dataset was structured into a presence matrix to facilitate visualization, filtering, and management. Upon approval by ICMBio's leadership, the updated IAS list was published on the official ICMBio website, ensuring transparency and accessibility.

Assessment methodology and indicators

At the end of the workshop, five key indicators were defined to ensure systematic monitoring and continuous improvement of the update process. The assessment will be conducted after three update cycles by the Technical Advisory Group (GAT, in Portuguese), as established during the event. The GAT will monitor, evaluate, and support the implementation of the update process by assessing the pre-established indicators. The defined indicators include:

1. Percentage of records evaluated within the deadline.

2. Number of list updates over a three-year period.

3. Percentage of FPA with available IAS records.

4. Total number of newly recorded IAS in FPA.

5. Percentage of FPA responding to monitoring questionnaires.

Implementation of the new update workflow for the IAS List

The entire process of updating the list fostered collaboration among 145 FPA (from a total of 340), 25 external experts to ICMBio, the CMEEI team, representatives from four other ICMBio departments, from 11 national research and conservation centers and five volunteers. These contributors played different roles throughout various stages of the process, which included not only reporting the occurrence of IAS but also the screening and validation of these data.

In addition to the occurrence data provided by the broad and target consultations, our team integrated data from five other databases: four databases from ICMBio Systems: the Federal Protected Areas Research Authorization System (SISBIO), the System for Analysis and Monitoring of Management Effectiveness (SAMGe), the Biodiversity Extinction Risk Assessment System (SALVE) and the National Biodiversity Monitoring Program (MONITORA) and the database of the Rio de Janeiro Botanical Garden.

The workflow for updating the IAS list was implemented throughout 2024. A total of approximately 60,000 potential records of invasive

alien species (IAS) were compiled, of which 2,576 were considered valid after a rigorous process of classification, screening, and validation. These records correspond to 290 IAS, including 162 invasive alien plant species and 128 invasive alien fauna species, occurring in 72% of FPA (246). The targeted consultations for distinct audiences and the consequent substantial influx of IAS records may explain the higher number of IAS records in FPA compared to the previous 2019 database. Specifically, 34 additional FPA reported the occurrence of IAS, and 69 new species were added to the list (Table 1).

The remaining validated records were classified into other categories, including non-invasive alien species, native opportunistic and non-opportunistic species, domestic species, and others. Approximately

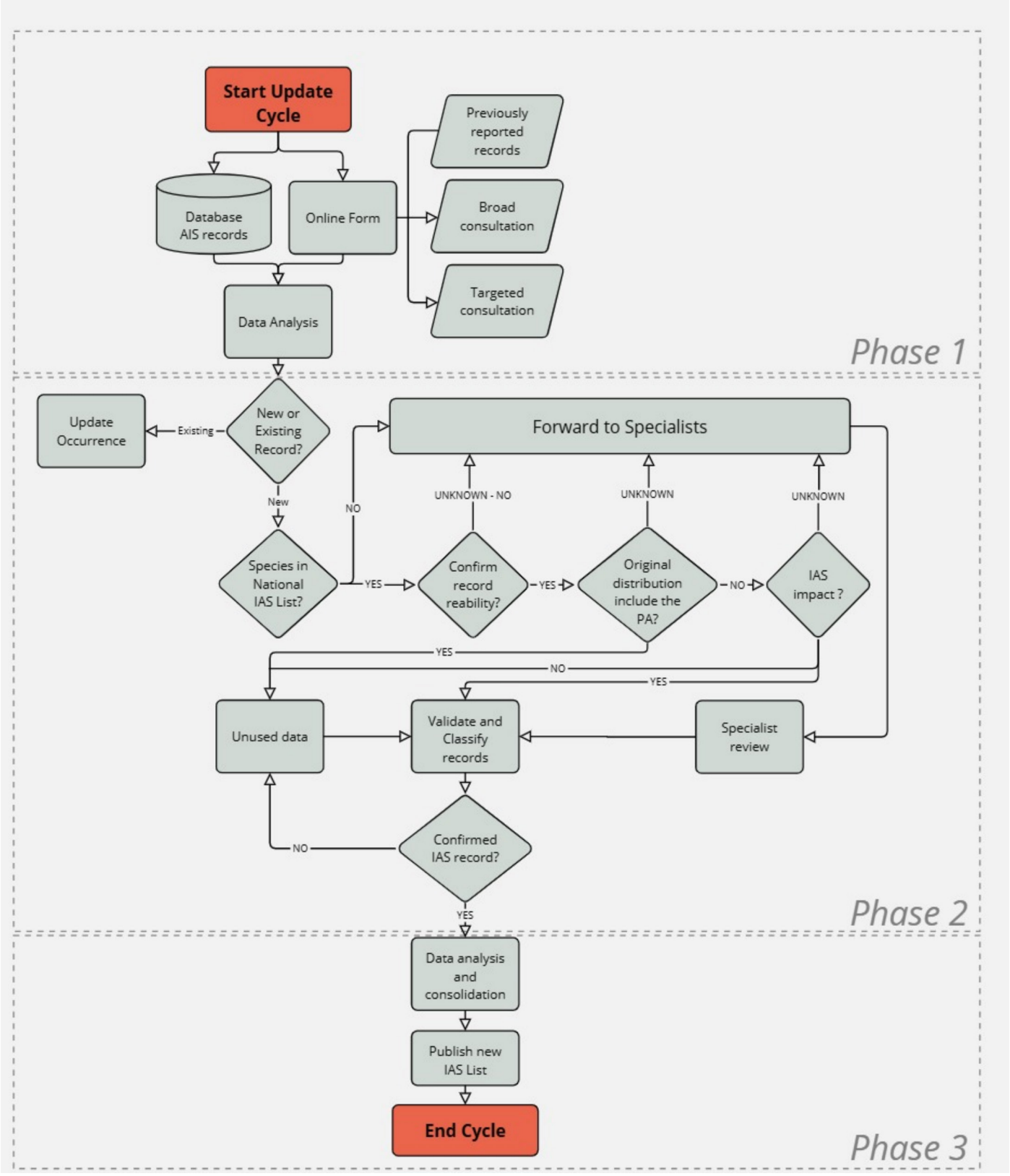

Figure 1. Flowchart of the new process for updating the Invasive Alien Species list in Federal Protected Areas, established by ICMBio in 2024.

49% of the records were classified as "insufficient information for classification." This category encompassed records that exhibited limitations such as unreliable evidence of occurrence within the FPA, uncertainties in taxonomic identification, lack of confirmation of the species' natural distribution range, and insufficient information regarding ecological impacts worldwide.

A comprehensive manual was developed to guide the periodic updating of the IAS list in FPA. This document outlines the specific steps of the update process, detailing each phase of the workflow to clarify the actions to be executed, identify the stakeholders involved, and establish defined timelines, thereby ensuring consistent and continuous implementation. This manual and the updated IAS list are publicly available for consultation on the ICMBio website, within the section dedicated to invasive alien species (https://www.gov.br/icmbio/pt-br/assuntos/biodiversidade/manejo-de-especies-exoticas-invasoras/listas-de-eei-em-ucs).

Table 1: Comparison of data on Federal Protected Areas (FPA) and Invasive Alien Species (IAS) from the 2019 list and the 2024 list, following the new updating process established by ICMBio.

		2019 List	2024 List
Number of IAS	Fauna	72	128
	Flora	149	162
	Total	221	290
Number of FPA with IAS	Fauna	186	227
	Flora	137	156
	Total	212	246

Discussion and Conclusion

The structuring and institutionalization of the new process of updating the IAS list in FPA represents a significant advancement in managing the threat of biological invasions in these areas, which are essential for the conservation of Brazilian biodiversity. This initiative constitutes a substantial institutional endeavor, evidenced by the extensive engagement of multiple stakeholders and institutional actors, particularly protected area managers, whose active reporting of biological invasion cases within their respective conservation territories was instrumental to the process. Approximately 60,000 potential records were compiled, of which 2,576 were validated, resulting in the addition of 69 new species to the IAS list. With this increase in information, a total of 290 IAS is now recorded in 246 FPA - representing about 72% of a total of 340 units. This expanded understanding is crucial for establishing a robust baseline and strengthening the strategic management of IAS within these areas (Guimarães Silva *et al.*2024; Marangon *et al.*2023; Sampaio & Schmidt 2013). Moreover, the monitoring indicators established in the workflow will support future assessments of the list's effectiveness for management decisions, linking periodic updates to measurable improvements in IAS detection, reporting, and prioritization within FPA.

This new update process revealed an increase in IAS across all taxonomic groups, with a particularly notable rise in the number of invasive alien fish species. The recorded fish species doubled, rising from 30 to 60, making fish the group with the highest number of representatives. These results are consistent with other surveys in Brazil, where systematic reviews have shown that plants, fishes, and mammals are the most frequently documented taxonomic groups of naturalized and invasive species (Zenni *et al.*2016; Frehse *et al.*2016; Figueiredo *et al.*2024; Zenni *et al.*2024). The increase in IAS records nationwide, beyond protected areas, likely reflects both reporting by managers and local communities and the role of human activities in facilitating dispersal, such as the spread of invasive fishes through aquaculture, fish farming, recreational fishing, dams, and water impoundments. Despite these efforts, biodiversity knowledge within Brazilian protected areas remains limited, with less than 1% of FPA thoroughly sampled, showing between 10 and 130 records per km² across different biomes (Oliveira *et al.*2017). Furthermore, even within the 72% of FPA where IAS have been recorded, considerable uncertainty remains regarding their full extent, highlighting the need for continued monitoring and research to better understand the true scope of biological invasions in these areas.

According to the *Thematic Assessment Report on Invasive Alien Species, Biodiversity, and Ecosystem Services*, the publication and periodic revision of IAS lists enhance public awareness of the issue and strengthen national management efforts (Ziller *et al.*2024). In this sense, the implementation of a standardized and optimized workflow, which integrates contributions from various sectors and stakeholders, promoting greater engagement, improves the availability and quality of IAS data, and enhances the capacity to address this threat in protected areas (Genovesi & Monaco 2013; Roy *et al.*2023). Furthermore, by enabling the prioritization of actions at local and regional scales, standardized data allows for a more targeted and efficient response, addressing the most pressing threats to biodiversity and ecosystem integrity.

The established workflow, along with the resulting list, received formal recognition through the publication of a federal regulation (ICMBio Ordinance No. 510/2025). Distinct from previously published lists, this list carries regulatory authority, having been instituted through an official act of the federal government. This regulation sets forth a series of incentives and obligations aimed at strengthening the effectiveness of control and eradication efforts for IAS within FPA. It also establishes a schedule for updating the list and defines shared responsibilities for its continuous revision, contributing to data quality and enabling its use in policymaking, as well as in the identification of priority areas and species for management. Furthermore, the formalization of this initiative at the federal level – combined with its broad dissemination through institutional platforms and scientific publications – fosters its replication by other governmental bodies in Brazil, including state and municipal environmental agencies, thereby reinforcing the national agenda on biological invasions.

A key provision of the ordinance establishes that, when more than one invasive alien species (IAS) occurs within the same FPA, its management team must define priorities for action based on the local ecological and management context. To support this process, the ordinance provides a technical instrument that assists managers in setting and justifying local priorities for IAS management. This tool offers a robust foundation for decision-making by considering variables such as local impacts, extent of occurrence, conservation targets, and feasibility of control or eradication. The regulation also recommends that FPAs included in the IAS list develop and implement specific management plans to address and mitigate the impacts of these species. Additionally, it establishes preventive control and monitoring measures aimed at reducing the risk of spread and preventing new biological invasions.

The updated process established has proven critical in addressing complex cases of species with conflicting ecological roles. For example, species such as *Muntingia calabura*, native to northern Brazil (Coutinho 2020) and valuable for various human uses (Mahmood *et al.*2014), can become invasive in southern regions due to their rapid growth and high dispersal capacity (Areces-Berazain 2022). Native species with restricted distributions or limited ecological data present specific challenges, and consultation with experts helps clarify uncertainties and prevent misclassification. Another case concerns widely cultivated fruit-bearing IAS, such as *Mangifera indica*, which remains among the most frequently reported species, not only because of its invasive potential, but also because it is easily recognized and commonly observed by the public. Information from databases and consultations contributes to the identification and inclusion of these species in the IAS list.

The context dependency of invasiveness represents a major challenge in species classification, as ecological impacts may vary across spatial scales, habitats, and management regimes. We acknowledge that a

species considered invasive in one region or ecosystem may not exhibit the same behavior elsewhere, due to differences in environmental conditions, disturbance regimes, or biotic interactions (Chiuffo *et al.*2022; Dyderski & Jagodziński 2019; Latzka *et al.*2016). For this reason, the list was developed using a precautionary approach that prioritizes evidence of global ecological impact as a consistent and scientifically grounded criterion for classification. This ensures comparability across taxa and regions while minimizing false negatives that could delay management responses. However, we also recognize that such an approach may lead to conservative classifications or potential false positives in certain contexts. To address this limitation, the framework adopted by ICMBio allows each protected area to interpret and apply the list according to its specific ecological conditions and management needs, ensuring that control and monitoring actions are locally relevant and proportionate to the actual risk.

The information on IAS occurrences provided by different sectors of society plays a central role in this new workflow, as it enables the collection of broad and decentralized data, increasing the geographical scope and promoting a better understanding of biological invasion dynamics, while encouraging public participation in science (Brown & Williams 2019; Roy *et al.*2023; Silvertown 2009). Furthermore, the encouragement of collaborative participation supports the continuous and periodic update of the list, ensuring that it remains a dynamic tool and serves as a reference for IAS management, while also guiding monitoring efforts and early detection of new species introductions (César de Sá *et al.*2019; Encarnação *et al.*2021; González-Moreno *et al.*2025). By promoting open access to reliable information, this approach enhances communication and engagement with diverse audiences, including the public, visitors, local communities, researchers, partners, and ICMBio collaborators. The process also integrates scientific expertise through contributions from specialists across different taxonomic groups to data validation, resulting in a more robust list and an increased transparency in the process, and consequently guiding better decision-making (Adriaens *et al.*2021; Balázs *et al.*2021; Johnson *et al.*2020).

A substantial proportion of the validated records were classified as inconclusive, reflecting the rigorous criteria applied during the validation process. Many of these records correspond to genus-level identifications, such as "*Eucalyptus spp.*," which hinder precise species-level validation. This issue is particularly common for invertebrates and certain plant groups in which species are morphologically similar, such as many grasses, requiring specimen collection and specialized expertise. In many cases, local contributors lack the logistical resource or taxonomic knowledge necessary for accurate identification. Only records supported by sufficient evidence through voucher specimens, photographs, or corroborated literature are definitively included in the IAS list. Records that do not meet these standards are maintained in a separate database, preserving potentially valuable information while preventing premature or erroneous inclusion that could lead to false positives in management and control decisions.

The high proportion of inconclusive records reflects the protocol's conservative and transparent approach, demonstrating its effectiveness in ensuring scientific certainty. By separating uncertain records, the method maintains the reliability and credibility of the IAS database while allowing adaptive management and future validation as additional evidence becomes available. However, the large volume of information generated by the new workflow increases analytical complexity and demands significant operational effort and human resources (Canhos *et al.*2004; Seebens & Kaplan 2022). It is important to recognize that this volume is partly associated with the initial implementation phase, since, until recently, information on IAS in Brazilian FPA was received in a fragmented and sporadic manner. The broad dissemination of the consultation period stimulated contributors to submit accumulated records, strengthening public engagement and awareness. In this context, incorporating automated procedures and digital solutions will be crucial to ensure efficiency and long-term sustainability. As successive update cycles are implemented, learning effects and procedural refinements are expected to progressively streamline validation routines and improve institutional responsiveness.

Furthermore, the consolidation of a transparent and standardized methodology creates favorable conditions for replication in other contexts, such as by state environmental agencies, thereby amplifying the initiative's positive impact and strengthening public policies for IAS management. These advances build upon previous investments in training, standardization, and the development of technical instruments, including the "Guide for the management of invasive alien species in federal protected areas" (ICMBio 2023) and other guidelines. Although the management process is regulated to some extent (ICMBio 2019), important gaps, particularly regarding control methods, and insufficient funding continues to limit implementation. While the list of IAS represents the success of the initiative within FPA, it is now crucial to encourage the development and publication of a comprehensive national list by the Brazilian Ministry of the Environment and Climate Change.

In conclusion, establishing a systematic process for updating the list of invasive alien species in federal protected areas represents an important milestone for environmental management in Brazil. Despite the challenges, the advances achieved provide a stronger foundation for addressing biological invasions through more coordinated, transparent, and evidence-based actions. Continuing methodological improvement, along with investments in training and technology, will be essential to ensuring the effectiveness and sustainability of this initiative in the long term.

Acknowledgements

We would like to express our sincere gratitude to all those who contributed to the development and success of this work. Our heartfelt thanks go to the teams from the federal protected areas who played a pivotal role by providing new IAS records. We are also deeply grateful to all the volunteers who meticulously screened and analyzed the data, as this work would not have been possible without their dedication. We extend our sincere appreciation to the ICMBio coordinations and the Rio de Janeiro Botanical Garden for making the necessary data available. We also thank the external experts who contributed valuable information to this project. Furthermore, we acknowledge the teams from ICMBio's National Research and Conservation Centers, whose data and participation in one of the stages of data analysis and validation were crucial to the success of this work.

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