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Indicator for Target 6 of the Kunming Montreal Global Biodiversity Framework CBD

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Training Course for Asia-Pacific States on Invasive Alien Species
15-17 July 2025 – Apia, Samoa

www.geobon.org

Target 6

Reduce the Introduction of Invasive Alien Species by 50% and Minimize Their Impact

Headline Indicator

Rate of invasive alien species establishment
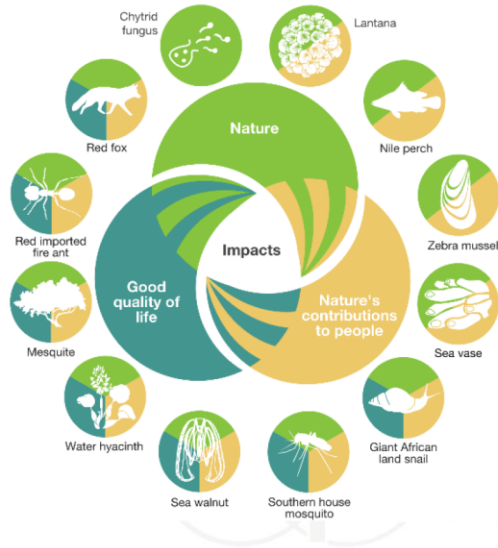
Rationale for indicator

People and nature are threatened by invasive alien species in all regions of Earth

37,000 established alien species have been introduced by human activities worldwide

200 new alien species every year

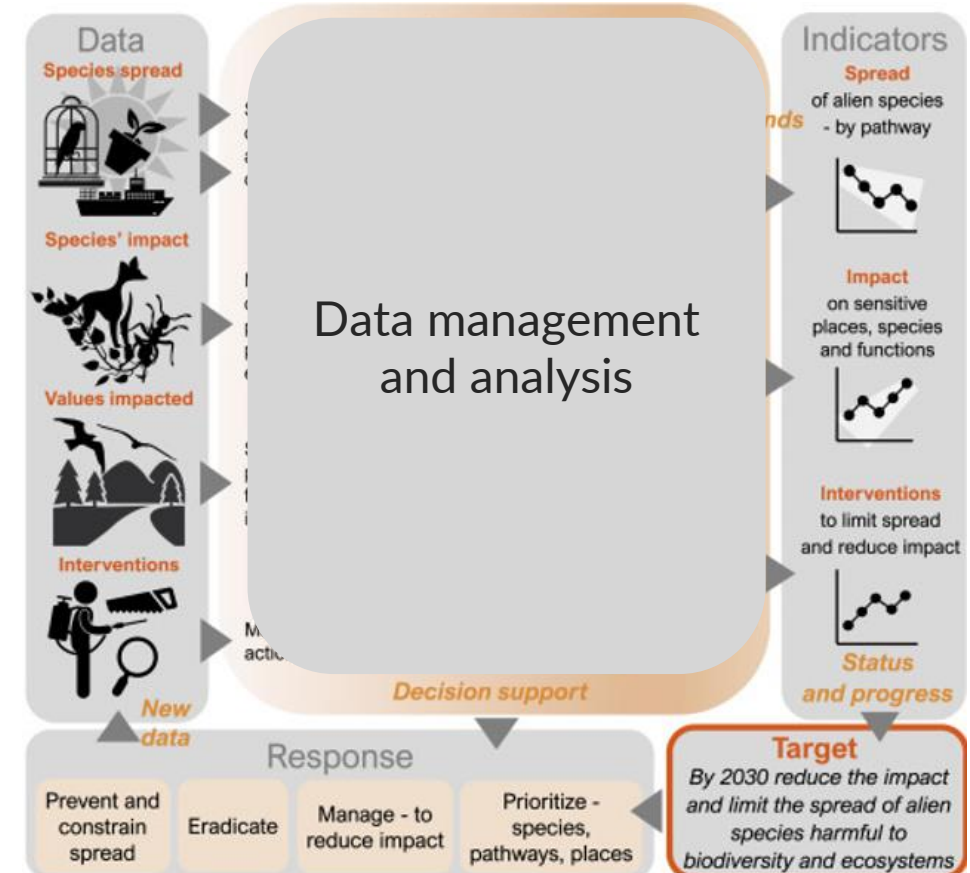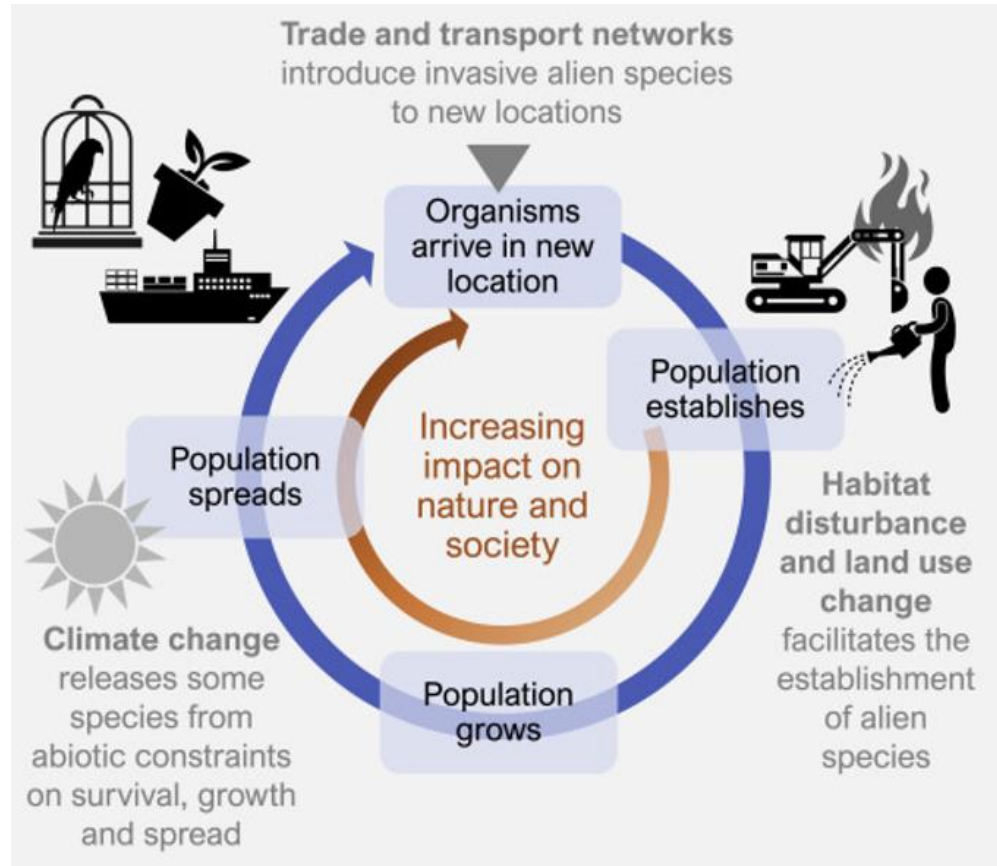3500 invasive alien species, with negative impacts on nature, and also on people
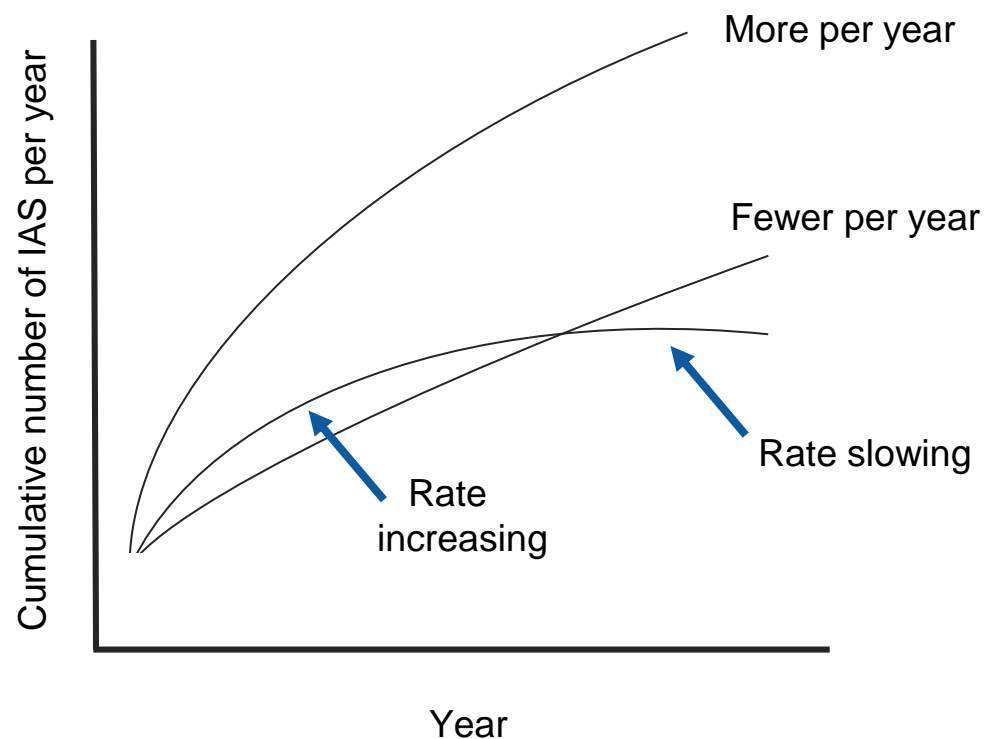
#InvasiveAlienSpecies Assessment

Key messages include:

Prevention is the most cost-effect approach to dealing with invasive alien species

Indicator rationale
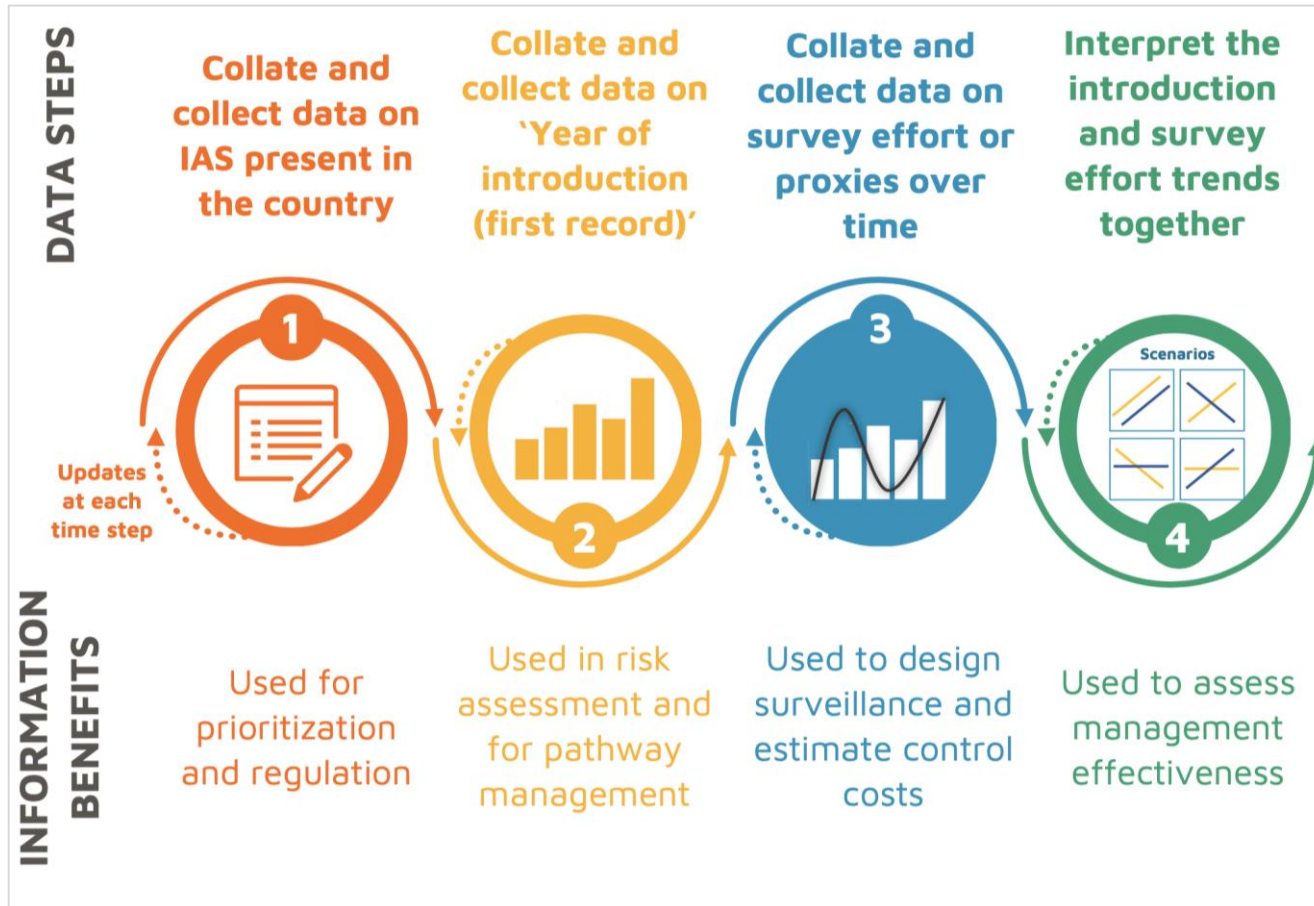
Headline Indicator: Rate of IAS establishment

Challenge

The number of observed new **IAS** per year

≠ the true number of new **IAS**

- Delays in detection
- Uneven detection effort over time
- Delays in data publishing or collation

Figure: Cumulative number of IAS per year vs. Year, showing curves labeled "More per year", "Fewer per year", "Rate slowing", and "Rate increasing".

Steps to calculate the indicator – Rate of IAS establishment

Data needs

1. A checklist of invasive alien species in the country or region

2. The observed or estimated year of introduction of each species

3. A measure of survey effort in each year

McGeoch *et al.* (2023). https://doi.org/10.1111/conl.12981   6

Data needed to calculate the indicator

1. A checklist of invasive alien species in the country or region

Global Register of Introduced and Invasive Species (GRIIS)

- GRIIS Country Checklists
- GRIIS Country Compendium

Pagad et al. (2018, 2022)

2. The observed or estimated year of introduction of each species

First Records Database

Seebens et al. (2017, 2020) https://doi.org/10.5281/zenodo.10039630

3. A measure of survey effort in each year

Examples of relevant data on the survey effort:
- hectares surveyed,
- numbers of inspections of high-risk establishment sites,
- volume of biosecurity inspections,
- numbers of new biodiversity records per year

McGeoch *et al.* (2023). https://doi.org/10.1111/conl.12981

Where to access GRIIS country checklists

Where to access GRIIS country checklists

- Cook Islands – https://doi.org/10.15468/tilinz

- Fiji - https://doi.org/10.15468/tzcqmv

- Kiribati, Rep. of - https://doi.org/10.15468/oiwqjh

- Marshall islands - https://doi.org/10.15468/zeu7p8

- Micronesia, Fed. States of - https://doi.org/10.15468/7fannv

- Nauru - https://doi.org/10.15468/68f7q6

- Palau - https://doi.org/10.15468/aqfghq

- Samoa, Ind. State of – https://doi.org/10.15468/oyhwrm

- Tuvalu - https://doi.org/10.15468/gv9tku

- Vanuatu - https://doi.org/10.15468/y38irh

LISTE TAXONOMIQUE | DATE D'ENREGISTREMENT 16 MAI 2018

Global Register of Introduced and Invasive Species -Samoa

Publié par Invasive Species Specialist Group ISSG

Pagad S • Wong L J • Myer B • Moverly D

ENSEMBLE DE DONNÉES   TAXONOMIE   PROJET   STATISTIQUES   ⬇ TÉLÉCHARGER   ⬔ PAGE D'ACCUEIL

386 ENREGISTREMENTS

Identifiant du projet BID-PA2016-0005-REG

Global Register of Introduced and Invasive Species GRIIS

Identifier GRIIS. The Global Register of Introduced and Invasive Species (GRIIS) presents validated and verified checklists of introduced (alien) and invasive alien species at the country, territory level. The development of the GRIIS is an initiative supported by the Secretariat of the Convention on Biological Diversity (CBD) and is implemented within the framework of the Global Invasive Alien Species Information Partnership. The IUCN SSC Invasive Species Specialist Group is the project lead. The resource will be a support to Parties to make progress to Achieve Aichi Target 9 -in the development of their National Biodiversity Strategy and Action Plans, their National Invasive Alien Species Strategy and Action Plan, target setting and monitoring.

Zone d'étude

GRIIS has global coverage, including the European Overseas Territories and Regions. Where appropriate, Sub-lists have been created for Oceanic Islands- for e.g. Soqotra of Yemen and the Juan Fernandez Islands of Chile.

Taxonomic coverage includes all Kingdoms Animalia, Bacteria, Chromista, Fungi, Plantae, Protozoa, Viruses.

The annotations recorded in GRIIS include- Species name and authorship, synonyms if used and authorship, Higher taxonomy (kingdom), Environment/system in which the species occurs, provenance or origin of the species, evidence of impact in that country, on biological diversity or natural areas and finally

Information in GRIIS country checklists

Taxonomic information

Alien status in country

Impact status

Common questions

Which set of species?

- (a) All aliens or (b) alien species with evidence of negative impact (Invasive alien species)
- Suggest use subset (b)

Negative impact where?

- (a) Anywhere, (b) regionally or (c) in focal country?
- Suggest use either (a) or (b)

What start year (baseline) to use?

- (a) since first historical records, or (b) since 1970, or (c) more recently?
- Suggest use (a) or (b) – or at least 30 years if possible

Two methods for calculating the indicator

1. Data method: Interpretive estimation of introduction rate (Method 1)
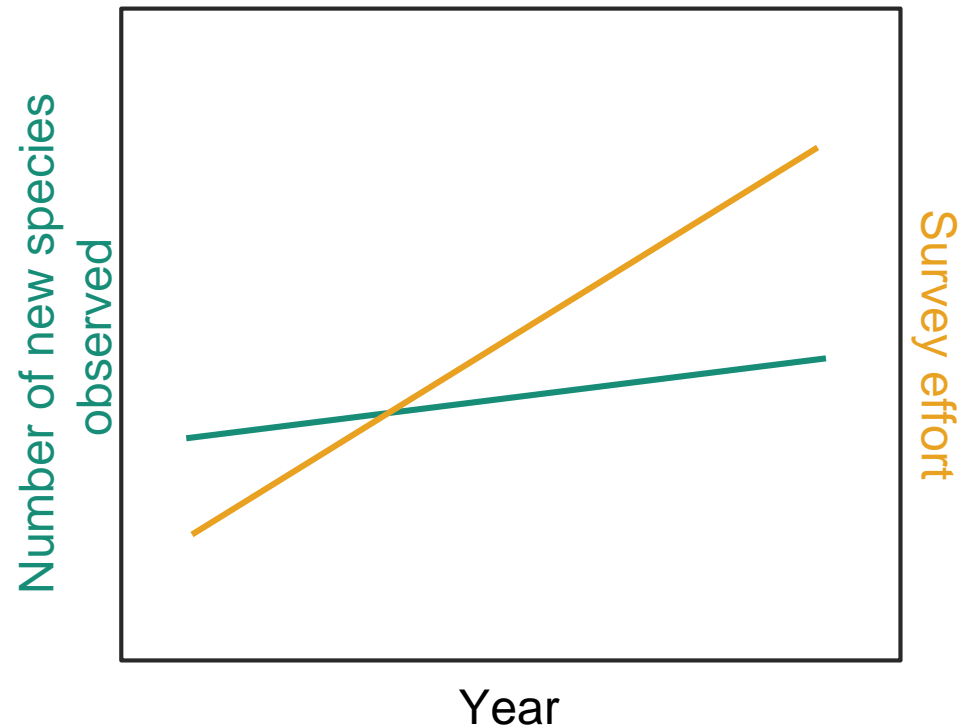
2. Modelling method: Model-corrected estimation of introduction rate (Method 2)

McGeoch *et al.* (2023). https://doi.org/10.1111/conl.12981
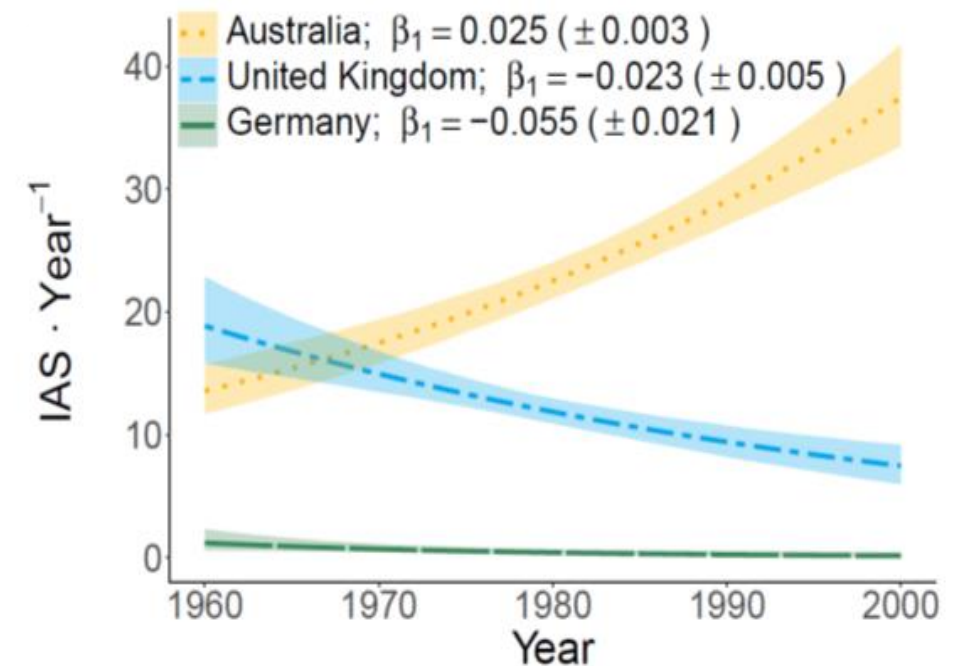
Interpretive data method (Method 1)
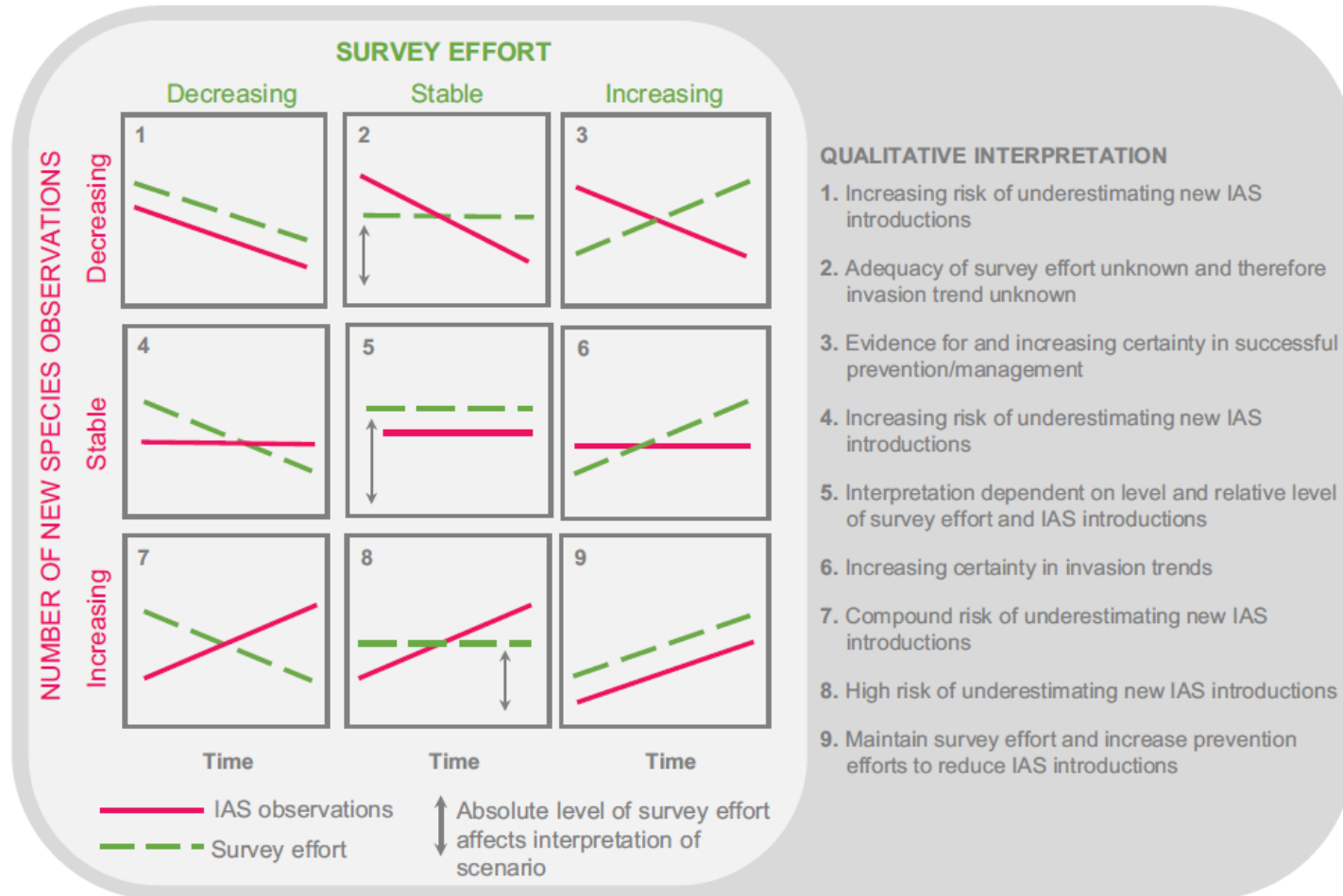
Model estimation (Method 2)

Australia; $\beta_1 = 0.025 \, (\pm 0.003)$
United Kingdom; $\beta_1 = -0.023 \, (\pm 0.005)$
Germany; $\beta_1 = -0.055 \, (\pm 0.021)$

How to do it

Methods in:

- Buba et al. 2024
  https://doi.org/10.1111/geb.13859

- Leihy et al. 2025
  https://doi.org/10.1029/2024EF005405

Plus resource
in development:
https://boninabox.geobon.org/
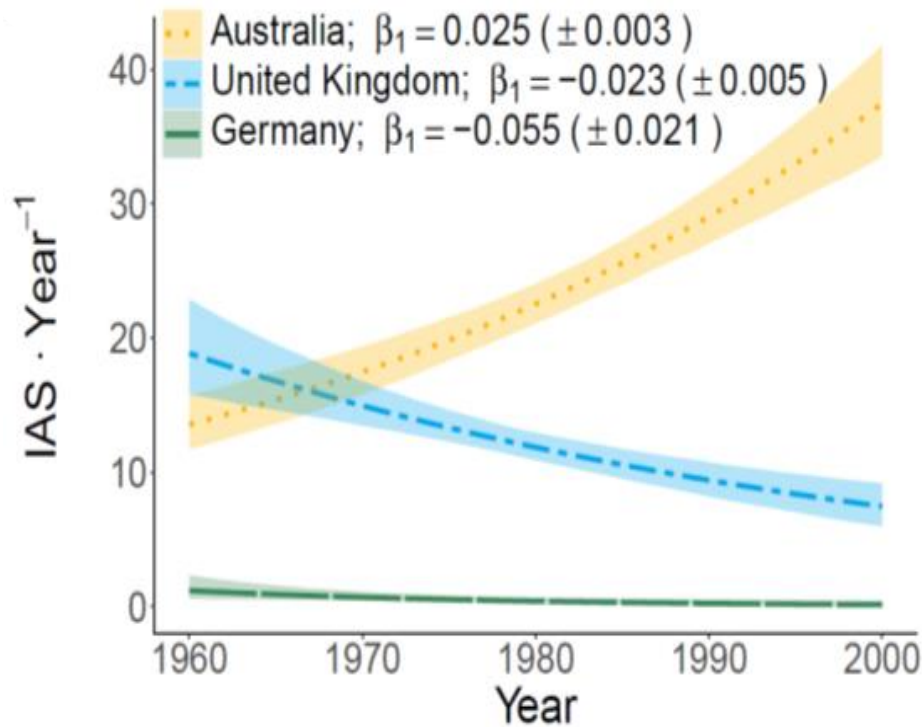
Example: Trends in introductions & survey effort

g) New Zealand Is.
$\beta_{1(n)} = -0.005;\ \beta_{1(s)} = -0.053;\ m = 5.13$
h) Prince Edward Is.
$\beta_{1(n)} = 0.015\ *;\ \beta_{1(s)} = 0.012;\ m = 2.91$
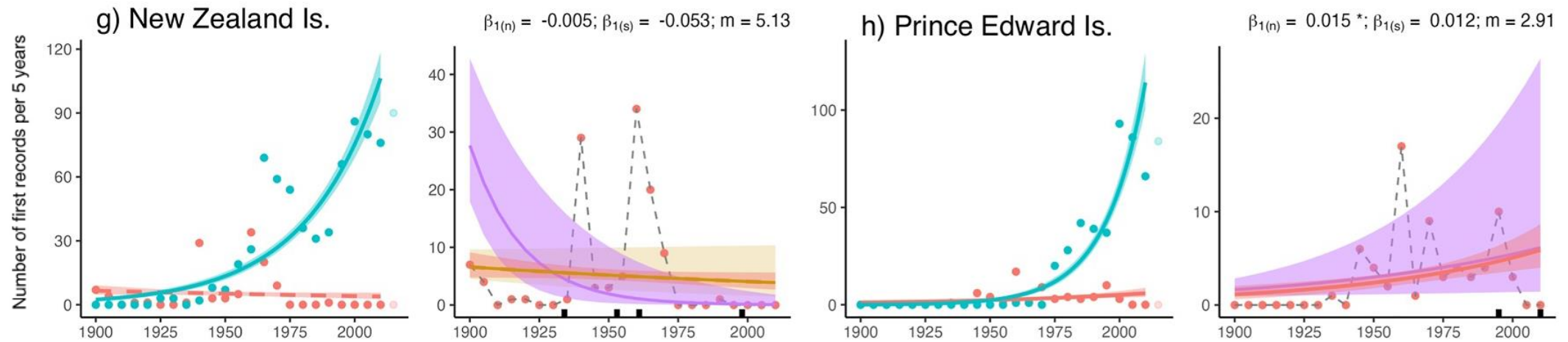
Legend
- Alien species observations
- Naïve model (perfect detection)
- Survey effort
- Sampling model (including survey effort data)
- Solow & Costello model (monotonic detection trend)

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Summary: The value of the indicator "rate of IAS establishment'

- Valuable, foundational policy indicators for biological invasions use information on species identity, species location (e.g. present/absent in a country), potential or realised threat/impact information, and are focused on prevention,

- Because this information has many other uses and is essential to invasion management, and because prevention is the most effective action and the most long-term management need that requires monitoring.

- Indicators for monitoring adaptive management progress rely on the above information and can include a range of other complementary information, such as eradications, land area controlled etc.

- Establishing a national indicator of rates of invasive species establishment is therefore strategic and provides a sustainable foundation for future reporting.

Contributors

And all co-authors of publications on the following pages...

Literature sources

Relevant Publications	Relevance
Vicente, J. R., Vaz, A. S., Roige, M., Winter, M., Lenzner, B., Clarke, D. A., & McGeoch, M. A. (2022). Existing indicators do not adequately monitor progress toward meeting invasive alien species targets. Conservation Letters, 15(5), e12918.	Review of all invasion indicators
McGeoch, M., & Jetz, W. (2019). Measure and reduce the harm caused by biological invasions. One Earth, 1(2), 171-174.	Framework for invasion monitoring
Pagad, S., Bisset, S., Genovesi, P., Groom, Q., Hirsch, T., Jetz, W., . . . McGeoch, M. A. (2022). Country compendium of the global register of introduced and invasive species. Scientific Data, 9(1), 391.	Data and methods
Seebens, H., Clarke, D. A., Groom, Q., Wilson, J. R., García-Berthou, E., Kühn, I., . . . Vicente, J. (2020). A workflow for standardising and integrating alien species distribution data. NeoBiota, 59, 39-59.	Dates of introduction
Groom, Q., Desmet, P., Reyserhove, L., Adriaens, T., Oldoni, D., Vanderhoeven, S., . . . Simpson, A. (2019). Improving Darwin Core for research and management of alien species. Biodiversity Information Science and Standards, 3. doi:10.3897/biss.3.38084	Data standards
McGeoch, M. A., Buba, Y., Arlé, E., Belmaker, J., Clarke, D. A., Jetz, W., . . . Winter, M. (2023). Invasion trends: An interpretable measure of change is needed to support policy targets. Conservation Letters, 16(6), e12981. doi:https://doi.org/10.1111/conl.12981	Indicator method (Method 1)
Pagad, S., Genovesi, P., Carnevali, L., Schigel, D., & McGeoch, M. A. (2018). Data Descriptor: Introducing the Global Register of Introduced and Invasive Species. Scientific Data, 5. doi:10.1038/sdata.2017.202	Data and methods
Henriksen, M. V., Arlé, E., Pili, A., Clarke, D. A., García-Berthou, E., Groom, Q., . . . McGeoch, M. A. (2024). Global indicators of the environmental impacts of invasive alien species and their information adequacy. Philosophical Transactions of the Royal Society B: Biological Sciences, 379(1902), 20230323. doi:doi:10.1098/rstb.2023.0323	Impact indicators
McGeoch, M. A., Ordonez, A., Howard, P. L., Groom, Q. J., Shrestha, B. B., Fernandez, M., Brugnoli, E., Bwalya, B., Byun, C., Ksenofontov, S., Ojaveer, H., Simberloff, D., Mungi, N. A., Rono, B. (2023). Chapter 6: Governance and policy options for the management of biological invasions. In: Thematic Assessment Report on Invasive Alien Species and their Control of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. . Retrieved from Bonn, Germany: https://doi.org/10.5281/zenodo.7430747	IPBES Assessment with indicator overview
Buba, Y., Kiflawi, M., McGeoch, M. A., & Belmaker, J. (2024). Evaluating models for estimating introduction rates of alien species from discovery records. Global Ecology and Biogeography, 33, e13859. https://doi.org/10.1111/geb.13859	Indicator method (Method 2)
Leihy, R. I., McGeoch, M. A., Clarke, D. A., Peake, L., Buba, Y., Belmaker, J., & Chown, S. L. (2025). Antarctic biosecurity policy effectively manages the rates of alien introductions. Earth's Future, 13, e2024EF005405. https://doi.org/10.1029/2024EF005405	Example of indicator method 2

Concepts to clarify when producing the indicator

TABLE 1 Clarifications needed when estimating invasion trends and introduction rates.

	Concept	Application
1	Delimitation of the intended species pool	Here, we use the definition under the Convention of Biological Diversity (https://www.cbd.int/invasive/WhatareIAS.shtml), and do not make a distinction between "alien" species and "invasive alien species" (IAS). The latter represent a subset of alien species and the argument in his paper applies in either instance.
2	Introduced versus established species	Here, the term introduction encompasses the introduction, establishment, and spread stages of the invasion process. These stages of the invasion process are in the main not possible to disaggregate for the purpose of empirical invasion trend modeling.
3	Invasion trend	A time series showing the change in the number of IAS in an ecosystem, country, region, or globally.
4	Introduction rate	The rate at which new species are introduced over a particular time period and for a particular region (subnational to global), calculated from the invasion trend.
5	Survey effort	Investment in surveillance and monitoring activities to observe (and document/report) newly introduced and established species. We assume for argument's sake here that "effort" constitutes effective and efficient surveys. Here, "survey effort" is synonymous with the term "discovery process" in Solow and Costello (2004).
6	Observed IAS	Detected and documented new IAS, recognizing that some IAS go undetected and unrecorded (synonymous with the term "discovery" in Solow and Costello, 2004).

Headline Indicator Rate of invasive alien species establishment

Component indicators:

- Rate of invasive species impact and rate of impact

- Rate of invasive alien species spread

- Number of invasive alien species introduction events

Complementary indicators:

1. Number of invasive alien species on national lists as per the Global Register of Introduced and Invasive Species

2. Trends in abundance, temporal occurrence and spatial distribution of non-indigenous species, particularly invasive, non-indigenous species, notably in risk areas (in relation to the main vectors and pathways of spreading of such species)

3. Red List Index (impacts of invasive alien species)

https://www.cbd.int/gbf/targets/6

Target 6

This target focuses on eliminating, minimizing, reducing or mitigating the impacts of invasive alien species in two main ways:

(a) by identifying and managing pathways to preventing their introduction and establishment and

(b) by eradicating or controlling invasive alien species that have been introduced and established.