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REVIEW

Island-restricted reptiles are more threatened but less studied than their mainland counterparts

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Abstract

Island ecosystems are disproportionately impacted by the ongoing Anthropocene defaunation. Although reptiles are unusually diverse on islands, and many require urgent conservation information, no overview of island-restricted reptiles (IRRs) distribution, threat status, and research effort has been carried out. Here, we assessed the research allocation to IRRs, contrasted these patterns with their mainland counterparts, and evaluated the impact of morphological, geographical, and socioeconomic predictors on research effort. Furthermore, we identified species-based research priorities based on the research outputs, threat status, and taxonomic distinctiveness. We found that although nearly one quarter of the planet's reptiles are IRRs and 30.1% are threatened, only 6.7% of the literature is devoted to IRRs and is biased towards a subset of few species. The Indo-Malayan realm harbors the greatest diversity of IRRs. Larger and more widely distributed species attracted more studies. In contrast, more recently described species located at higher altitudes were less studied. Most top-ranking reptile species in terms of research priority were IRRs. Overall, our findings suggest that current research levels are insufficient to inform evidence-based conservation and emphasize the critical need to target research towards less known species and geographic regions.

KEYWORDS
conservation, endemic species, island reptiles, knowledge gap analysis, research effort

1 | INTRODUCTION

With over 12,000 species, non-avian reptiles represent one-third of the extant terrestrial vertebrates (Roll et al., 2017; Uetz et al., 2025). Since the beginning of the 21st century, more than 100 reptile species have been described yearly, and the description rate seems far from flattening (Uetz et al., 2025). They inhabit myriad habitats, where—through important ecosystem functions such as arthropod suppression, pollination, seed dispersal, and ecosystem engineering—they contribute to ecosystem resilience and stability (Doody et al., 2021; Esposito et al., 2021; Valencia-Aguilar et al., 2013).

At the global level, at least one in five reptile species is currently threatened (Cox et al., 2022). Indeed, reptiles are one of the most susceptible vertebrate groups to human disturbance (Newbold, 2018) and are increasingly impacted by anthropogenic factors such as agriculture, logging, pollution, and invasive species (Farooq et al., 2024; Sparling et al., 2010). Yet, their knowledge exhibits numerous shortfalls, leading to approximately 15% of the extant species being categorized as Data Deficient by the International Union for Conservation of Nature (IUCN), a figure that contrasts with, for example, 0.5% for birds (Cox et al., 2022; IUCN, 2025). This poses a significant challenge to reptile conservation, as studies on squamates show that over 20% of Data Deficient or not classified species may be threatened (Wotherspoon et al., 2024).

Islands account for less than 7% of the Earth's surface area (Sayre et al., 2018) yet are home to a disproportionate amount of the world's biodiversity (Kier et al., 2009; Tershy et al., 2015). Due to a wide array of evolutionary pressures, island speciation is particularly high, and a considerable proportion of island biota is composed of island endemics (Bellemain & Ricklefs, 2008; Jønsson & Holt, 2015; Kier et al., 2009). Reptiles have several physiological and behavioral traits—e.g., impermeable skin and ability to withstand long periods without food or water—that make them particularly good island colonizers (Chapple et al., 2012; Silva-Rocha et al., 2019). This, combined with factors such as fewer interspecific competitors, predators and parasites, associated with greater ecological plasticity of insular reptiles in comparison with their mainland counterparts, often translates into high reptile density and ecological relevance in island ecosystems (Ali & Meiri, 2019). The isolated nature of islands also creates distinctive abiotic conditions and unique intra and inter-species dynamics that facilitate reptile speciation (Fernández-Palacios et al., 2021; Rato et al., 2024). This often translates into rapid evolutionary rates and frequent radiation events, such as that of *Tarentola* geckos in the West African archipelago of Cabo Verde (Vasconcelos et al., 2012) or *Anolis* lizards on the Caribbean (Losos & Schneider, 2009). At a larger scale, a particularly good example of the relevance of island ecosystems to reptile conservation is Madagascar, which despite occupying less than 0.4% of the Earth's total land area is home to >450 species, roughly 3.8% of all known extant reptiles and comprising 25% of all IUCN threatened reptile species (Spatz et al., 2017).

Island ecosystems tend to be highly sensitive to human disturbance and are particularly affected by habitat loss, overharvesting, and biological invasions (Ceballos et al., 2015; Dawson et al., 2017; Reaser et al., 2007; Spatz et al., 2017). Islands host around half of the world's threatened species (Spatz et al., 2017), and roughly one in four extinctions since the expansion of Europeans around the globe occurred on islands (Fernández-Palacios et al., 2021; Tershy et al., 2015). Globally, around 90% of the historical reptile extinctions corresponded to island-restricted species (Bochaton et al., 2021; Slavenko et al., 2016), and these high extinction rates might—at least partly—be linked to knowledge deficits (Gumbs et al., 2020). Island species are often less studied, resulting in limited ecological and conservation data to inform management actions (Conenna et al., 2017; de Lima et al., 2011). Moreover, conservation research tends to be unevenly distributed across taxa and geographic areas (Brooke et al., 2014), biased towards more high-profile or charismatic species (Ducarme et al., 2013; Speight et al., 2025), and often fails to provide meaningful information to support effective interventions (Sutherland et al., 2019).

Multiple gap analyses have investigated research biases in numerous taxa, including marine mammals (Jarić et al., 2015), primates (Chen et al., 2023), amphibians (da Silva et al., 2020), and even reptiles at a global scale (Guedes et al., 2023; Speight et al., 2025). Acknowledging the uniqueness of island biota, some studies have examined the research patterns associated with island-restricted species—see, e.g., de Lima et al. (2011) for birds, or Conenna et al. (2017) for bats. However, despite the importance of islands for global reptile conservation, and the relevance of reptiles for island ecosystems, to date no study has specifically investigated research allocation on island-restricted reptiles. Understanding research allocation is crucial for guiding conservation priorities, funding allocation, and environmental policy, as well as identifying potential mismatches between scientific attention and conservation needs.

Here, we analyze the research effort allocation on island-restricted reptiles (IRRs), by assessing taxonomic, spatial, and threat status-related patterns, to identify literature biases and target conservation priorities worldwide. Specifically, we address the following questions: (i) When compared to their mainland counterparts, are IRRs understudied at the species and family levels? We predict that IRRs receive less research attention, with few species accounting for most research outputs; (ii) How are total research outputs and conservation-relevant literature (i.e., studies associated with the assessment of the effectiveness of conservation interventions) distributed across realms and IUCN Red List Categories? We hypothesize that IRRs inhabiting realms in the Global North (e.g., Nearctic and Palearctic) will be more studied (Beheregaray, 2008), and that threatened IRRs (CR, EN, and VU) are expected to have more conservation-relevant research (Chapman & Peres, 2021; Wang et al., 2024); (iii) What are the key taxonomic, biological, and socioeconomic drivers of research effort on IRRs and do these factors influence research focus on IRRs and non-IRRs in similar ways? Species traits (e.g., range size and body mass), along with the availability of research funding, are expected to positively influence the allocation of research effort. However, given the intrinsic characteristics of islands—such as limited area and geographic isolation—some drivers, such as range size, are anticipated to exert stronger effects on IRRs. Lastly, based on threat status, research effort, and taxonomic distinctiveness, we prioritized IRRs for future studies.

By identifying existing gaps and elucidating patterns of research allocation among insular reptile species, this study aims to establish a foundation for more effective conservation action. It provides insights into how research effort is distributed in relation to species' taxonomy, geographic location, and threat status, thereby informing priorities for future research investment and guiding evidence-based management strategies.

2 | METHODS

2.1 | Data sources

IRRs were defined as reptile species restricted to any island (or group of islands) smaller than Australia. Towards this end, a list of islands' endemic reptile species was obtained from Meiri (2024). For each species, the most recent IUCN Red List category was obtained from The IUCN Red List of Threatened Species (https://www.iucnredlist.org, 2021).

In quantifying the research attention received by each species, we used the number of research outputs per reptile species—defined as the number of published scientific papers—as reported in the dataset compiled by Guedes et al. (2023). This dataset provides species-specific bibliometric data extracted from the Scopus database, one of the most comprehensive searchable abstract and citation sources for scientific literature, covering the period between 1960 and 2021. Bibliometric data was searched for 11,570 species, which corresponded to all known reptile species according to the May 2021 release of the Reptile Database (Guedes et al., 2023; Uetz et al., 2025). Species described after 2015 were not included in the Guedes et al. (2023) database as to reduce potential bias due to their recent discovery and taxonomic instability (Guedes et al., 2023), leading to a total of 10,531 species. The number of research outputs was obtained by searching for the species' accepted name and all known synonyms in the title, abstract, or keywords of publications indexed in Scopus. Further methodological details and potential limitations of this compilation can be found in Guedes et al. (2023).

To identify which species have been the focus of conservation-related studies, the total conservation research outputs, defined as scientific studies that have assessed the effects of conservation interventions on reptile biodiversity, were obtained from Speight et al. (2025), previously extracted and adapted from the Conservation Evidence database (www.conservationevidence.com). To construct the Conservation Evidence database, a subject-wide evidence synthesis approach is used to systematically scan the conservation literature using a standardized protocol of manual searching throughout all published issues of conservation-relevant journals, as well as non-journal literature sources relevant for a given taxa, habitat, or topic of the assessment (see Sutherland et al., 2019 for details—and limitations—of the subject-wide evidence synthesis methodology, and Sainsbury et al., 2021 for details about the Reptile Conservation synopsis). This metric was chosen as a reflection of the available evidence to guide conservation practice. Since general research might not be directly targeting conservation specifically (Murray et al., 2015), these outputs can provide actionable insights for management.

Information regarding biogeographical realm (assigned based on the percentage of overlap with species range) was obtained from Guedes et al. (2023). Taxonomic classification of the species was obtained from Tonini et al. (2016), Zheng and Wiens (2016), and Guedes et al. (2023).

2.2 | Biases in research effort between IRRs and non-IRRs

We investigated differences in equitability of total general research and total conservation research outputs among IRRs and non-IRRs using Pielou's evenness index (Pielou, 1966), varying between 0 and 1, with 1 representing here an equivalent number of publications distributed between species. Additionally, this index was also used to investigate how evenly the total and conservation-relevant literature is distributed within IUCN Red List categories and biogeographic realms. Differences among categories and realms were further explored using the Kruskal–Wallis rank test followed by a post hoc Dunn's test.

At the family level, the most studied families were ranked by the median research output values and the least studied families were ranked by the percentage of species in each family with no research outputs. This allowed us to investigate if IRRs were disproportionately represented at either extreme of families with the most or least research outputs.

2.3 | Drivers of research effort in IRRs and non-IRRs

The relative importance of key morphological, phylogenetic, geographical, and socioeconomic factors on the research effort allocation was investigated using general linear mixed effects models (GLMMs) as in Guedes et al. (2023), but with the key difference that IRRs and non-IRRs were considered separately. Therefore, models were built for non-IRRs species (also referred to as mainland species), IRRs and for the three realms with the highest IRRs richness (Indo-Malayan, Australasian, and Neotropical). We included some of the predictors used by Guedes et al. (2023), namely body mass, threat status, number of biological institutions (museums, herbaria, and universities), purchasing power parity, and year of description (see Table S1, Supporting Information for additional information regarding model predictors description and source). Range size was obtained from Caetano et al. (2022), while maximum and minimum elevation where the species is present (as indicators of ecological tolerance) from Meiri (2024). Additionally, as highly phylogenetically distinct species (e.g., tuatara) might be considered evolutionarily irreplaceable, thereby attracting more research attention, particularly in evolutionary biology and conservation science, models included a score of evolutionary uniqueness as a predictor. For this, we used the EDGE of Existence Programme evolutionary distinctiveness (ED) score, which accounts for the total phylogenetic diversity of a clade among its members. The score emphasizes evolutionary uniqueness, and the more unique the evolutionary lineage of a species, the higher its ED score (Zoological Society of London, 2020). Model predictors were tested for multicollinearity using the variation inflation factors (VIF), excluding those with VIF >10, and log 10 transformed to correct for skewness. Following Guedes et al. (2023), IUCN threat status was z-transformed to convert it into an ordinal variable. Species classified as Data Deficient (DD), Extinct (EX), and not listed in the IUCN Red List were excluded, since for them considerable lack of information was already expected, and indeed these categories do not represent threat statuses. Species without information for at least one of the predictors were also excluded from the analysis. This led to a final database of 1150 IRRs (including 304 Indo-Malayan IRRs, 194 Australasian IRRs, 261 Neotropical IRRs) and 3908 non-IRRs. Each model included family as a random term, as more closely related species are likely to exhibit similar patterns of research effort (Ducatez & Lefebvre, 2014). Model selection was based on AIC and to determine the importance of each predictor we used the “MuMIn” package in R (Bartoń, 2025). Best fitted models were checked for residuals dispersion and deviation of simulated residuals using “DHARMa” package (Hartig, 2024).

2.4 | Research prioritization

We used a research priority metric (RPM) as described by Roberts et al. (2016) and adapted by Conenna et al. (2017) to identify species-level priorities for future research. The RPM was defined as

$$\mathrm{RPM} = \mathrm{ROi} + \mathrm{ERi} + 0.5^{*}\mathrm{CSi} + 0.5^{*}\mathrm{ROCSi}.$$

Following Roberts et al. (2016) and Conenna et al. (2017), the parameters, calculated separately for each IRRs, were:

1. ROi—total research output (RO) index, obtained by dividing RO by the maximum RO recorded among IRRs, and subtracting it from 1. It ranges from 0 to 1, where 1 corresponds to species with no RO.
2. ERi—extinction risk index, ranging from 0 to 1, where 1 represents threatened species (VU, EN, and CR) and 0 non-threatened (LC and NT). Data Deficient and species not listed in the IUCN Red List were accounted for by assigning a value of 1 when the species was a single-island endemic and the cumulative area of islands occupied was <400,000 km^2, a value of 0.5 when only one of these conditions was verified and 0 when none of them was met.
3. CSi—index of number of congeneric species, obtained by dividing the number of congeneric species (CS) by the maximum CS recorded among IRRs and subtracting it from 1. The index ranges from 0 to 1, with 1 representing species with no recorded congenerics.
4. ROCSi—index of research output among CS. It was obtained by calculating total general RO among CS,

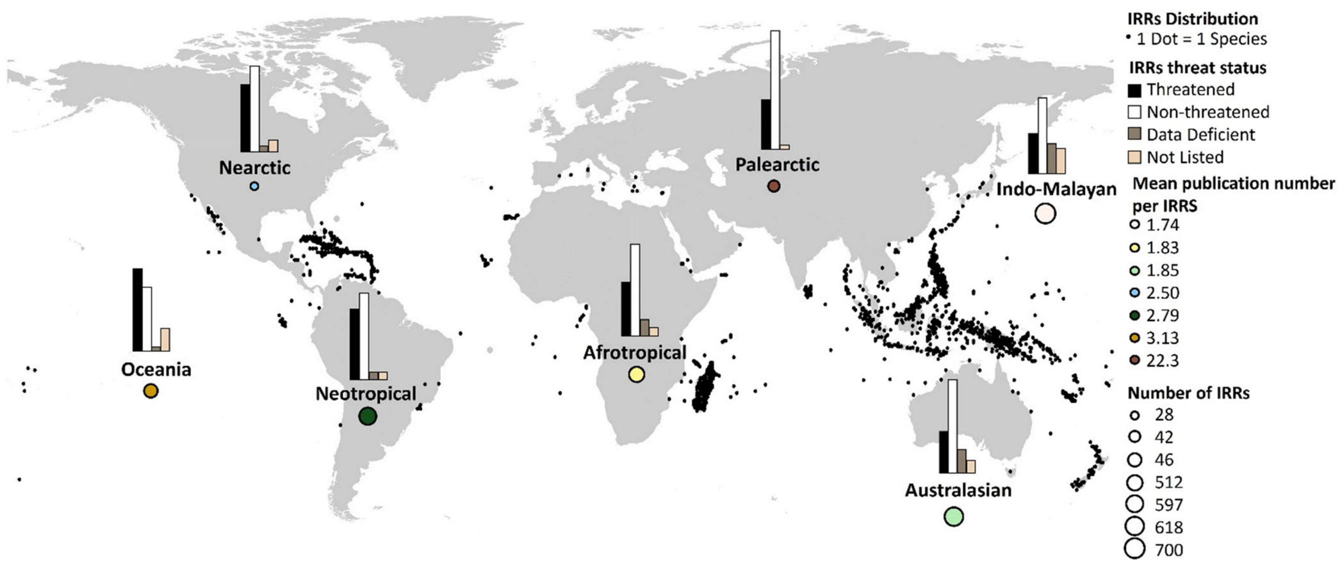

FIGURE 1 Distribution of island-restricted reptiles (IRRS) and research effort directed towards them, among the seven biogeographic realms. Dots represent single IRRS species, positioned at the mean latitude and longitude of all their recorded occurrences. Symbols are assigned for each realm: circles show the total number of IRRS (as the size of the circle) and mean publication number per IRR (as the different color); bar charts represent percentages of threatened (Red List categories Vulnerable, Endangered, and Critically Endangered), non-threatened (categories Least Concern and Near Threatened), Data Deficient species and species Not Listed in the IUCN Red List.

and then dividing the value by the maximum total general RO among CS recorded and finally subtracting it from 1. This index ranges from 0 to 1, where 1 represents no RO among CS.

The RPM ranges between 0 and 3, where species with a high RPM value correspond to highly threatened species, with low research effort in general and among island congenerics, as well as high taxonomic distinctiveness.

3 | RESULTS

3.1 | Threat status and distribution of island-restricted reptiles

We found 2543 IRRs, corresponding to approximately 21% of all extant reptile species described in the Reptile Database. Over one quarter (765 species, 30.09%) of the IRRs are currently threatened (i.e., classified as Vulnerable [VU], Endangered [EN], or Critically Endangered [CR]), more than double the proportion of threatened non-IRRs (941 species, 12.06%). Although the proportion of threatened species was always greater for IRRs than for their mainland counterparts for all threat categories, the most noticeable difference was for species classified as EN (13.0% for IRRs [331 species] vs. 5.09% [397 species] for non-IRRs). However, the proportions of IRRs and non-IRRs currently not assessed in the IUCN Red List or classified as Data Deficient (DD) were relatively similar (not assessed 8.22% [209 species] for IRRs vs. 11.9% [931 species] for non-IRRs; DD: 11.2% [284 species] for IRRs vs. 9.01% [703 species] for non-IRRs) (Table S2).

The biogeographic regions with the highest richness of IRRs were the Indo-Malayan ($N = 700$), Australasian ($N = 618$), and Neotropical ($N = 597$) realms, while the Nearctic realm contained the lowest species richness ($N = 28$). However, the greatest percentages of threatened IRRs were found in Oceania, followed by the Nearctic and the Neotropical realms (Figure 1).

3.2 | Biases in research effort allocation between IRRs and non-IRRs

Although IRRs accounted for 21% of the reptile diversity, only 6.7% of the reptile-associated research outputs were devoted to them (6115 papers across 2543 species vs. 82,880 papers across 7801 species, for IRRs and non-IRRs, respectively). Indeed, IRRs were substantially understudied compared to non-IRRs (2.4 ± 0.241 vs. 10.6 ± 0.742 papers per species, respectively; mean ± SE) and nearly half (47.7%) of the IRRs lack any research outputs (vs. 34.8% for non-IRRs). The top 10 most studied IRRs account for 26% of papers, while this figure came down to 16% of papers for the top 10 most studied non-IRRs

TABLE 1 (a) Top 10 most studied reptile families, ranked by median research outputs (RO); (b) top 10 least studied reptile families, ranked by the percentage of species with zero studies.

(a)

Family	Example of species	Median RO	Number of species	Number of RO	% species on islands
Dermochelyidae	Leatherback sea turtle	720	1	720	0
Cheloniidae	Typical sea turtles	625	6	5792	0
Sphenodontidae	Tuataras	385	1	385	100
Alligatoridae	Alligators	137.5	8	2081	0
Gavialidae	Gharials	93	1	93	0
Crocodylidae	Crocodiles	50.5	16	1739	18.8
Carettochelyidae	Pig-nosed turtle	48	1	48	0
Platysternidae	Big-headed turtle	45	1	45	0
Shinisauridae	Chinese crocodile lizard	34	1	34	0
Podocnemididae	Pleurodire turtles	24.5	8	366	12.5

(b)

Family	Example of species	% species with 0 RO	Number of species	Number of species with 0 RO	% species on islands
Cadeidae	Cuban keel-headed worms	100	2	2	100
Cyclocoridae	Philippine burrowing snakes	85.7	7	6	100
Gerrhopilidae	Indo-Malayan blindsnakes	70.6	17	12	64.7
Diploglossidae	Galliwasps	67.3	49	33	49
Typhlopidae	Typical blind snakes	63.6	261	166	31.8
Prosymnidae	Shovel-snout snakes	62.5	16	10	0
Leiocephalidae	Curly-tailed lizards	60.7	28	17	82.1
Cylindrophiidae	Asian pipe snakes	58.3	12	7	75
Atractaspididae	Atractaspidid snakes	56.7	67	38	0
Leptotyphlopidae	Thread snakes	54.2	131	71	9.9

(Table S3a). Yet, according to Pielou's evenness index, research evenness for IRRs and non-IRRs was similar ($J = 0.771$ and 0.727 for IRRs and non-IRRs, respectively).

3.3 | Taxonomical patterns

Research outputs were unevenly distributed across reptile families. Overall, Viperidae accounted for the bulk of research outputs (16,385 papers, 18.4%). Yet, Dermochelyidae, a family with a single living member (the Leatherback sea turtle *Dermochelys coriacea*), had the greatest median research outputs (720; Table 1(a)).

IRRs were only present in 3 of the 10 most studied families and, with the exception of the family of the tuatara (Sphenodontidae), IRRs were underrepresented in these families ($< 20\%$ of the species were island-restricted; Table 1(a)). IRRs were overrepresented in the top 10 least studied families, with half of the top 10 least studied families being mostly composed of IRRs. Indeed, only two of these families, the snakes Prosymnidae and Atractaspididae, were exclusively composed of mainland species (Table 1(b)).

At a deeper phylogenetic level, we found a significant mismatch between the amount of research outputs on IRRs belonging to different reptile suborders and the proportion of threatened species within each suborder (Figure 2). Crocodilians (Crocodylia), wall lizards, and whiptail lizards (Lacertoidea) had the highest number of research outputs in relation to the number of threatened species within each suborder (33.5 and 31.3 studies per threatened species, respectively). On the other hand, geckos (Gekkota) and blind skinks (Dibamidae) were the least studied in relation to the number of threatened species within the suborder (4.3 and 3.0 studies per threatened species, respectively) (Figure 2).

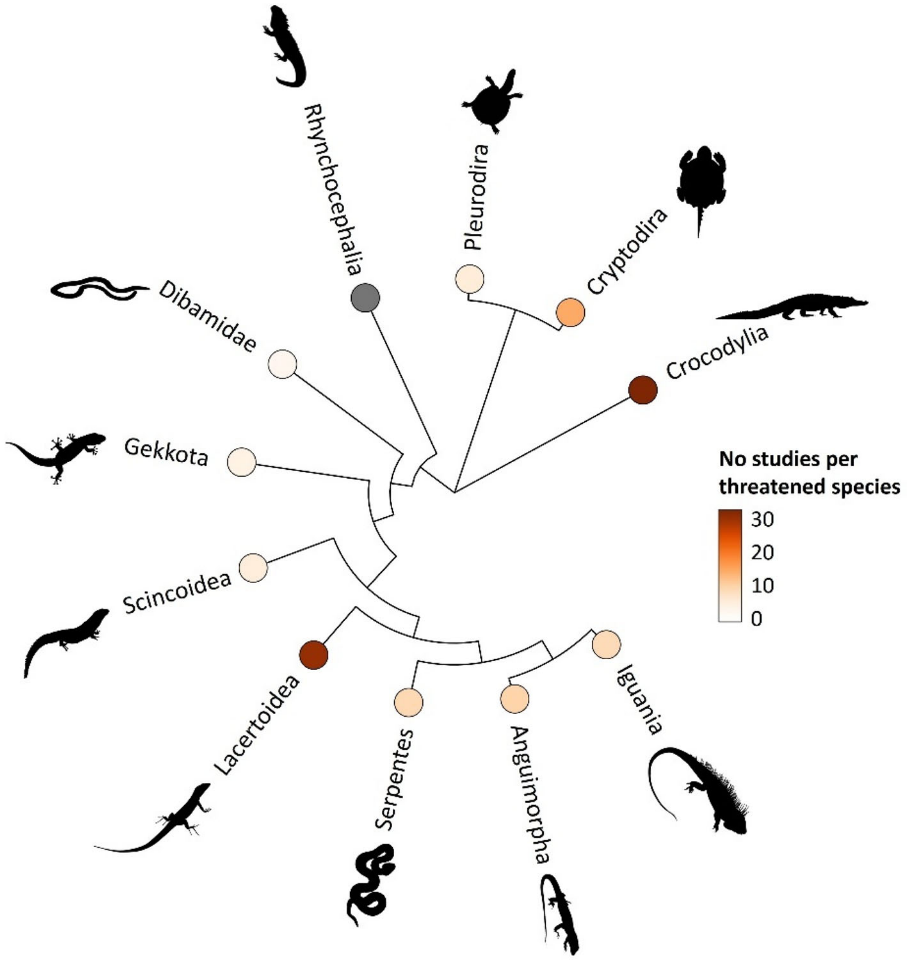

FIGURE 2 Phylogeny of island-restricted reptile suborders, with branch color-coded according to the number of research outputs in proportion to the number of threatened species. The darker the orange the greater the ratio of research output to the number of threatened species. As Rhynchocephalia is a monospecific order with only one extant, non-threatened, species (*Sphenodon punctatus*), it is featured in gray.

No IRRs were represented among the 10 most studied reptile species. Indeed, the four most studied reptiles, *Chelonia mydas*, *Caretta caretta*, *Trachemys scripta*, and *Naja naja* accounted for 7478 papers (2130, 2058, 1709, and 1581, respectively), more than all the IRRs combined. *Protobothrops flavoviridis*, belonging to the Viperidae family, was the most studied IRR, with a total of 477 papers (Table S3b).

3.4 | Research effort across realms and threat categories

From a total of 1279 conservation research outputs identified, only 91 studies were targeting IRRs (0.036 papers per species on average, vs. 0.15 for non-IRRs).

Both total and conservation research outputs were unevenly distributed among biogeographic realms for both IRRs (total: $\chi^2 = 191.65$, *p*-value <.001; conservation: $\chi^2 = 26.48$, *p*-value <.001) and non-IRRs (total: $\chi^2 = 610.06$, *p*-value <.001; conservation: $\chi^2 = 635.52$, *p*-value <.001). Palearctic, one of the most species-poor biogeographic realms in terms of IRRs but harboring multiple research centers in herpetology, concentrated the highest amount of research outputs per IRRs (22.3 papers per species on average). On the other hand, the Indo-Malayan realm—home of the greatest number of species but with fewer local-based research groups—had the lowest number of research outputs per IRRs (1.74) (Figures 1 and 3). Nearctic, the realm with the lowest number of IRRs but home of world-leading herpetological research, had the greatest number of conservation research outputs (a total of 38 conservation-related papers), whereas Oceania had no conservation research outputs recorded in the database (Figure 3).

Likewise, both total and conservation research outputs varied according to IUCN threat categories for both IRRs (total: $\chi^2 = 148.44$, *p*-value <.001; conservation:

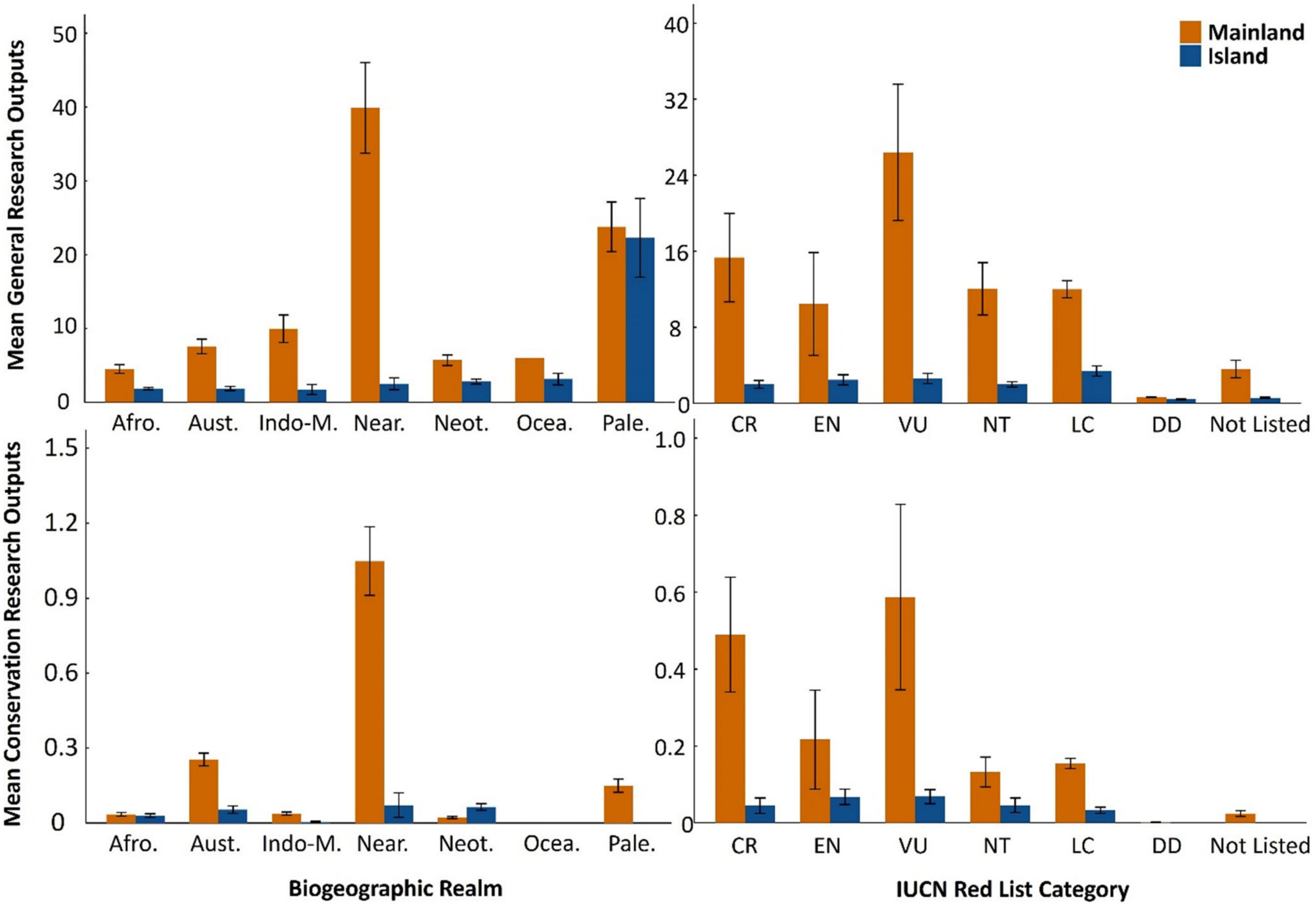

FIGURE 3 Distribution of mean general and conservation research outputs (RO) per species on mainland and island-restricted reptile species (IRRS) within biogeographical realms (Afro., Afrotropical; Aust., Australasian; Indo-M., Indo-Malayan; Near., Nearctic; Neot., Neotropical; Ocea., Oceania; Pale., Palearctic) on the left, and IUCN Red List categories (CR, Critically Endangered; EN, Endangered; VU, Vulnerable; NT, Near Threatened; LC, Least Concern; DD, Data Deficient; Not listed, species not assessed in the IUCN Red List) on the right panel.

$\chi^2 = 26.46$, p-value <.001) and non-IRRs ($\chi^2 = 497.25$, p-value <.001; conservation: $\chi^2 = 115.98$, p-value <.001). Yet, research effort was more evenly distributed across threat categories for IRRs than for their mainland counterparts, which means that per IUCN category species tend to have a similar number of research outputs. In mainland species, Pielou's evenness index was lower for all threat categories (VU, EN, and CR), thus indicating that several species are disproportionately studied or neglected within each IUCN category (Figure 3 and Tables S4 and S5).

3.5 | Drivers of research effort

For both IRRs and non-IRRs, greater body mass and range size led to higher research effort. IUCN status and proximity to more biological institutions were only significantly positive for mainland species. On the other hand, more recently described species and inhabiting higher elevations (considering the minimum elevation species were found, so the base elevation of their distribution) were associated with fewer studies. Purchasing power parity had a positive effect on research effort directed to mainland species, but a negative effect for IRRs (Figure 4).

Research targeting IRRs in three realms considered (Indo-Malayan, Australasian, and Neotropical) followed the same pattern, being positively affected by body size and negatively by year of description. The number of nearby biological institutions positively affected research in the Indo-Malayan and Australasian realms, while purchasing power parity followed the same trend as for general IRRs, negatively affecting the research effort. The evolutionary distinctiveness (ED) score only affected Indo-Malayan and Neotropical IRRs, having a considerably small positive effect (Figure 4 and Table S8).

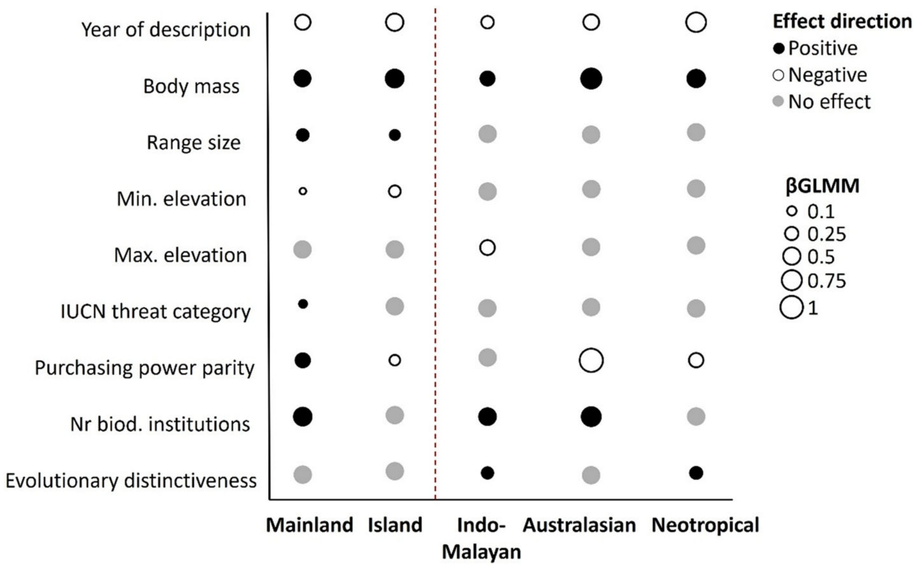

FIGURE 4 Summary results of GLMMs investigating morphological, geographical, conservation, and socioeconomic factors on the research effort allocation of mainland species, island-restricted reptiles (IRRS), and IRRS belonging to the Indo-Malayan, Australasian, and Neotropical realms. The symbol size is proportional to the effect of each predictor in the model. The color represents the direction of the effect. See Table S8 for additional modeling results.

TABLE 2 Top 15 reptile species identified by the research priority metric as the most in need of research, ranked in order of research priority.

Species	Family	Realm	IUCN category	Number of RO	IRRs	RPM
Anoplohydrus aemulans	Colubridae	Indo-Malayan	DD	0	Yes	3
Chalcidoseps thwaitesi	Scincidae	Indo-Malayan	EN	0	Yes	3
Complicitus nigrigularis	Agamidae	Indo-Malayan	DD	0	Yes	3
Cyclotyphlops deharvengi	Typhlopidae	Australasian	VU	0	Yes	3
Heurnia ventromaculata	Homalopsidae	Australasian	DD	0	Yes	3
Karnsophis siantaris	Homalopsidae	Indo-Malayan	NC	0	Yes	3
Myersophis alpestris	Cyclocoridae	Indo-Malayan	DD	0	Yes	3
Sumatranus albomaculata	Homalopsidae	Indo-Malayan	DD	0	Yes	3
Techmarscincus jigurru	Scincidae	Australasian	VU	0	No	3
Tetralepis fruhstorferi	Colubridae	Indo-Malayan	VU	0	Yes	3
Xyelodontophis uluguruensis	Colubridae	Afrotropical	EN	0	No	3
Brygophis coulangesi	Pseudoxyrhophiidae	Afrotropical	VU	1	Yes	2.9995
Chapinophis xanthocheilus	Colubridae	Neotropical	EN	1	No	2.9995
Etheridgeum pulchrum	Colubridae	Indo-Malayan	DD	1	Yes	2.9995
Graciliscincus shonae	Scincidae	Australasian	VU	1	Yes	2.9995

Note: Island-restricted reptile species are highlighted in bold.

3.6 | Research priorities

Twelve out of the 15 reptile species with the highest research priority metric score were IRRs (Table 2). Of these, eight were from the Indo-Malayan realm, three from Australasia, and one from the Afrotropics. The top 11 species had a maximum RPM value of 3 (indicating species with no research outputs, no congeneric species, restricted geographic distribution, and either threatened or Data Deficient).

4 | DISCUSSION

Our results show that although IRRs face higher extinction risk than their mainland counterparts, they lag behind in terms of research attention. This aligns with previous findings for island-restricted birds (de Lima et al., 2011) and bats (Conenna et al., 2017), being less studied than non-island-restricted species.

4.1 | Research disparity between IRRs and non-IRRs

Due to a multitude of factors, including smaller and more fragmented distribution ranges, lower and more singular genetic diversity, simpler and fragile ecological relations, and greater susceptibility to human disturbance, island species are more likely to be threatened than non-island species (Fernández-Palacios et al., 2021; Tershy et al., 2015). Some of these peculiarities also contribute to greater rarity (Fernández-Palacios et al., 2021), which combined with island-specific characteristics such as greater geographic isolation, could be a key factor explaining the low general research effort on IRRs.

Worryingly, we found that only a small subset of conservation studies was directed at IRRs (91 studies, corresponding to 7% of studies identified in the Reptile Conservation Evidence synopsis; Sainsbury et al., 2021). Insular systems are particularly vulnerable to anthropogenic disturbances such as invasive species and habitat loss and degradation (Farooq et al., 2024; Sparling et al., 2010). Abundant conservation work tends to take place in island settings (e.g., Donihue et al., 2021; Graham et al., 2024), and indeed most birds and mammals benefiting from conservation are island-restricted species (Bolam et al., 2021). Although the small number of conservation studies devoted to IRRs might reflect some limitations associated with the subject-wise literature search strategy used to compile the Conservation Evidence database (discussed in Sutherland et al., 2019), it nonetheless signals the urgent need to augment the research attention devoted to IRRs. This is particularly pressing considering our findings that over 30% of the IRRs are currently categorized as threatened.

There was a poor representation of IRRs in the most studied reptile families, while they are overrepresented in the least studied families. Particular traits, such as features associated with charisma, are known to influence research allocation (e.g., Marshall et al., 2016). On islands, populations evolving to become significantly smaller or larger than their mainland counterparts (dwarfism/gigantism; Lomolino, 2005) can attract greater research attention. The capacity to produce and inoculate humans with life-threatening venom is likely to be a key driver of research effort, and accordingly it is somewhat unsurprising that Viperidae—to which *Protobothrops flavoviridis*, the top-ranking IRRs in terms of research efforts belongs—was disproportionately studied in relation to other reptile families. Similarly, features associated with the phylogenetic uniqueness of the island-restricted tuataras (which diverged from lizards and snakes at about 250 million years ago; Jones & Cree, 2012), likely influence the research attention devoted to Sphenodontidae.

When it comes to geographic patterns, the Palearctic had the most even distribution of studies between IRRs and non-IRRs. The Mediterranean basin and the Macaronesian archipelagos, belonging to the Palearctic, are among the best-studied areas for reptiles (see, e.g., Sherpa et al., 2024). Indeed, one of the top 10 most studied IRRs, *Gallotia galloti*, is endemic to the Canary Islands, in Macaronesia. Biological communities of these islands are not only subject to ecological, evolutionary, and physiological studies, but also to several conservation-directed projects, related to the control and eradication of invasive species, and their impact on the native fauna (Montes et al., 2022; Nunes et al., 2022; Piquet & López-Darias, 2021). The Afrotropics had one of the smallest differences in research outputs between IRRs and non-IRRs. In line with previous finds that the Afrotropical realm is generally understudied (Farooq et al., 2021), we found that both Afrotropical IRRs and non-IRRs had a low research output. This is particularly concerning as the Afrotropics contain Madagascar, one of the most reptile-diverse islands globally (Uetz et al., 2025) with approximately 98% of its reptiles being endemic (Antonelli et al., 2022).

4.2 | Drivers of research allocation to IRRs

In line with previous studies (e.g., Schmidt et al., 2023), range size was positively correlated with the number of research outputs, suggesting that the smaller the area where a species is distributed, the less studied it tends to be. Likewise, species at higher altitudes were also less studied, especially when considering the minimum altitude of their distribution. This is in line with recent findings for bats, for which Data Deficient species were found to be more prevalent in mountain areas (Chakravarty et al., 2024). In the case of reptiles, lower temperatures and higher humidity at higher altitudes can reduce the activity period of reptiles (Zamora-Camacho et al., 2013), thus reducing their suitability as research models, by reducing their likelihood of being sampled.

On the other hand, species' body mass positively influences the number of research outputs. Larger species tend to receive greater research attention (Moura et al., 2018). One of the key "island syndromes" is that insular fauna tends to be characterized by gigantism in small animals and dwarfism in large animals (Benítez-López et al., 2021; Meiri, 2007). These particularly small or large sizes can increase the charisma and general interest in a species, leading to more directed research funding (Berti et al., 2020; Prokop et al., 2022; Roll et al., 2016). Nonetheless, this was not reflected in our results, as IRRs and non-IRRs were affected by body size in similar ways. An interesting result was related to the purchasing power parity, which had a positive effect on research effort directed to mainland species, suggesting that wealthier countries tend to invest more in reptile research. On the contrary, for IRRs this effect was negative. Several biodiversity hotspots are in areas with low purchasing power parity. This often attracts international attention and research efforts from wealthier countries, leading to a disproportionate contribution from mainland-based institutions to the study of IRRs (see Andreone et al., 2024 for a call for more collaboration between foreign and national researchers in the IRR-rich island nation of Madagascar). In islands with higher purchasing power parity, funds might be directed to other areas, such as an increment of tourism, and thus developing more urban infrastructures (Bruner et al., 2004; Reaser et al., 2007). Interestingly, when looking into the three most diverse realms, purchasing power parity had a stronger negative effect on research effort in two of them, while the number of biological institutions had a positive effect.

4.3 | Priority setting

IRRs—comprising 12 of the top 15 highest-ranking species for research priority—are overrepresented in the taxa with the greatest RPM scores. Of these, more than half are Data Deficient or not categorized by the IUCN. Notwithstanding that this somewhat reflects the more general patterns that 21% of squamates are classified as Data Deficient (Wotherspoon et al., 2024), it is nonetheless problematic, as species that are not categorized as threatened often tend to be excluded from conservation legislation (Cazalis et al., 2023). Furthermore, species ranking highly on the RPM tend to be monophyletic, thus harboring high levels of phylogenetic uniqueness (Cardillo, 2023; Gumbs et al., 2020; Hébert et al., 2021), a frequently neglected dimension of biodiversity that should be prioritized in future research.

4.4 | Limitations and conclusions

A key limitation of this study is that the database compiled by Guedes et al. (2023) relied exclusively on the Scopus database. Hence, some relevant studies only recorded in the so-called "gray literature" may have been unintentionally omitted. Nonetheless, we found that IRRs had a mean of 2.4 research outputs per species (and a mean <1 when considering conservation-based literature), far lower than other taxonomic groups. European birds for example average 96 papers per species (Murray et al., 2015), and even island-restricted bats have an average of 4.3 publications per species, allowing for a far richer knowledge base for conservation action. It is essential that future assessments incorporate not only conservation-relevant literature published in scientific journals, but also reliable information from other sources, such as reports from NGOs, government agencies, and national institutions responsible for management actions (e.g., invasive species control). These additional sources may contain valuable insights into overlooked or undocumented conservation efforts. There is an urgent need to synthesize and review this diverse body of information—covering as many languages as possible (Amano et al., 2021)—and ensure that this information is accessible and usable by researchers, policymakers and practitioners (Sutherland et al., 2019). By conserving the biodiversity of insular reptiles, we can help to safeguard the ecosystems and processes in which they play a critical role. However, bridging the significant knowledge gap between IRRs and non-IRRs requires a targeted step increase in research focus, in addition to continued capacity building and collaboration with island-based researchers and institutions.

AUTHOR CONTRIBUTIONS

The study conceptualization and design were performed by Ricardo Rocha, Sara F. Nunes, Kane Powell, Rui Rebelo, and Mar Cabeza. Data analyses were conducted by Sara F. Nunes and Kane Powell. Writing original draft preparation was led by Sara F. Nunes and Ricardo Rocha. All the co-authors contributed comments and revisions to drafts of the manuscript. All authors have approved the submitted version of this manuscript.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The database on reptiles research outputs and predictors is available in Guedes et al. (2023) (https://doi.org/10.

1111/ecog.06491) and Meiri (2024) (https://doi.org/10.1111/geb.13812).

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