The intersection between elected representatives and threatened species recovery

Authors

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Abstract

A core objective of the conservation movement is to motivate government decision-makers into delivering critical policy changes to abate the global species extinction crisis. Using Australia as a case study, we showcase a way of highlighting the intersection between a nation's elected representatives and extant threatened species. We analyse the relationship between Australia's 151 Commonwealth Electoral Divisions (CEDs) and the distributions of 1,651 nationally listed threatened species. We show all CEDs contain at least 14 threatened species and nearly half of the species analysed (n=801, 49%) are confined to just one CED (n=44), with 1345 (81%) species intersecting with < five CEDs. These findings demonstrate the importance of enumerating the crisis to better understand the responsibility elected representatives have to their local region and constituents. Linking species distributions to political geography creates data that can be used by the conservation movement to motivate environmental accountability and leadership.

Introduction

The global species extinction crisis is being driven by insufficient responses to historical and ongoing human-led impacts on biodiversity (IPBES, 2019). There are five well-established interventions directed at policy-makers for addressing the deterioration of nature, namely incentives and capacity building, cross-sectoral cooperation, pre-emptive action, decision-making in the context of resilience and uncertainty, and environmental law and implementation (IPBES, 2019). The existence and global emphasis of these interventions highlight the importance of policy design and implementation, and the role of governments that institute them in delivering conservation outcomes (Rose et al., 2018). For successful management to occur at the scale needed to recover threatened species, relevant levels of government need to implement bold conservation plans founded on effective interventions (Sutherland et al., 2018; IPBES, 2019; Díaz et al., 2020). Research to explore and improve the activities that happen at the science-policy interface will be critical to motivate these interventions (Toomey et al., 2017; Rose et al., 2018).

National governments often determine the trajectory of progress in nature conservation (Watson et al., 2021) and thus are a common focus for advocates looking to address the extinction crisis. Central to the activities of most national governments are elected representatives since they design and oversee the implementation of policies that are currently constraining better outcomes for species (IPBES, 2019). In many democracies, representatives are elected based on principles of geographical representation which identifies a region from which the constituency expresses approval for agents to stand for and act on their behalf (Urbinati & Warren, 2008; Brenton, 2010). This provides an incentive for elected representatives to represent the interests and opinions of their constituencies. This system supplies elected representatives with an opportunity for some ownership of, and responsibility for, local social, economic, and environmental issues within the region represented. Thus, there is substantial scope for electoral constituents to demand action from representatives for recovery of their local threatened species (Rose et al., 2018). However, this can only be achieved if the conservation community, constituents, and their representatives understand the distribution of threatened species in relation to regions of representation (Rose et al., 2018).

Here we showcase a new way of communicating the responsibility of a nation's elected representatives, highlighting the potential individual and collective role in threatened species recovery. Australia has been a representative liberal democracy for over a century. Australia is also at the forefront of the extinction crisis, having lost over 100 endemic species since European invasion and the highest mammalian extinction rate of any continent over that period (Creswell et al., 2021). We compare how threatened species vary across Australia's Commonwealth Electoral Divisions (CED), or colloquially known as 'electorates', and the extent to which they are associated with the area of a CED, and its demographic profile. Given the crisis facing threatened species across Australia, we discuss how this type of information could be used by the conservation community to help inform wider societal dialogue and debate in generating responsibility and solutions by government. We then explore how this information could help inform the roles of elected representatives in overcoming the current constraints on abating Australia's species extinction crisis.

Methods

Australian threatened species

We used the Species of National Environmental Significance (SNES) database listed by the Australian Department of the Environment and Energy's Threatened Species Scientific Committee and Minister under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) (Commonwealth of Australia, 2021) (retrieved 1st July 2021). There were 1,961 threatened species listed at the time of analysis, with 1,633 (83%) distributions generalised to 1km grid cells and 328 (17%) sensitive species generalised to 10km. Following Lloyd et al. (2020), we used "species or species habitat is likely to occur within area" distributions as this is the more definitive (than "may occur") and represents an approximation of the area of occupancy of species as opposed to their extent of occurrence. We confined the data to species relevant to the geographical electoral system. Species with no recorded threatened status, or with the Extinct, or Conservation Dependent statuses were removed (Ward et al., 2021) such that only Vulnerable (VU), Endangered (EN), and Critically Endangered (CR) listings remained. Marine species and cetaceans were excluded to restrict the data to species inhabiting terrestrial and freshwater regions that intersect CEDs.

Australia's federal electoral system

Australia's parliament operates on a bicameral system, which involves citizens voting for two houses of parliament. The continent of Australia, Tasmania and numerous smaller islands are divided into 151 single-representative CEDs for elections to the House of Representatives (Parliament of Australia, 2018). The CEDs are drawn on human population distribution with quotas for the states and territories of the Commonwealth prior to an election. We used the House of Representatives 2021 federal electoral boundaries and their demographic classification drawn for the 2022 election (Australian Electoral Commission, 2022). The spatial CED data was cropped to include mainland Australia, Tasmania, and offshore territorial islands (i.e., Torres Strait islands, Kangaroo island) and exclude remote external territories (i.e. Christmas, Cocos, and Norfolk Islands) for simplicity. Due to the non-uniform human population distribution across Australia, CEDs vary in size. The largest CED is Durack (1,387,445 km^2, Western Australia (WA)), which is over 50,000 times the size of the smallest, the inner metropolitan CED of Sydney (28 km^2, New South Wales (NSW)). The median size of CEDs is 363 km^2. The Australian Electoral Commission categorises CEDs into four demographic classifications: inner metropolitan, outer metropolitan, provincial, and rural. CEDs of provincial (25) and rural (38) demography represent 42% of all CEDs (n=151, Table S1), yet account for 99% of the total area of CEDs in Australia. CEDs of inner (45) and outer metropolitan (43) demography account for 0.37% of the total area of CEDs in Australia (Table S1). These classifications are assigned on proximity to metropolises, suburban history, and voting enrolment criteria (Australian Electoral Commission, 2022).

Spatial analysis and modelling of CEDs and threatened species

After filtering for EPBC listed species that intersect with CEDs, 1651 species remained to be used in this study (Table S2). All spatial and statistical analysis was conducted in R (v4.2.1; R Core Team, 2021), using tidyverse (Wickham et al., 2019) and sf (Pebesma, 2018) packages. We identified the species with ranges that intersected with each CED (7,815 unique species-CED combinations) to create a list of each CED's species. From this, we summarised the CED coverage of each species based on the number of CEDs they intersected with. To quantify the spatial overlap, we calculated the intersection of species' distributions and CEDs, and used this to filter for 'CED endemism'. We define 'CED endemism' in this study as species with 100% of their geographic distribution within a single CED or whose (terrestrial and freshwater-based) range only intersects with a single CED.

We used the Dorling equation (Dorling, 1996) to redefine the spatial shape of each CED to the weighted variable of number of threatened species within them. This enables static mapping of Australia's CEDs as due to the large size differences they are not conducive to a choropleth map (Tennekes, 2018; Jeworutzki, 2020). We used the empirical cumulative distribution function to calculate the proportion of threatened species at each number of CEDs within a species' range as proportion is a more informative metric than raw counts. To test the relationship between number of species within each CED and their area, we used the logarithmic ($\log_2$) form of the power model, commonly used to describe the species-area relationship (Matthews et al., 2019). We used a $\log_2$ transformation to address the order of magnitude differences between the areas of CEDs and enable visual comparisons between the four demographic classifications on a scatterplot.

Results

Threatened species within CEDs

Threatened species occurred in all 151 CEDs, with a range of 14-271 and median of 39 (Fig. 1, Table S1). The CED of O'Connor (WA), the third largest, contained the most (n= 271) threatened species while Hindmarsh (South Australia (SA)) contained the fewest (n=14) (Fig. 1).

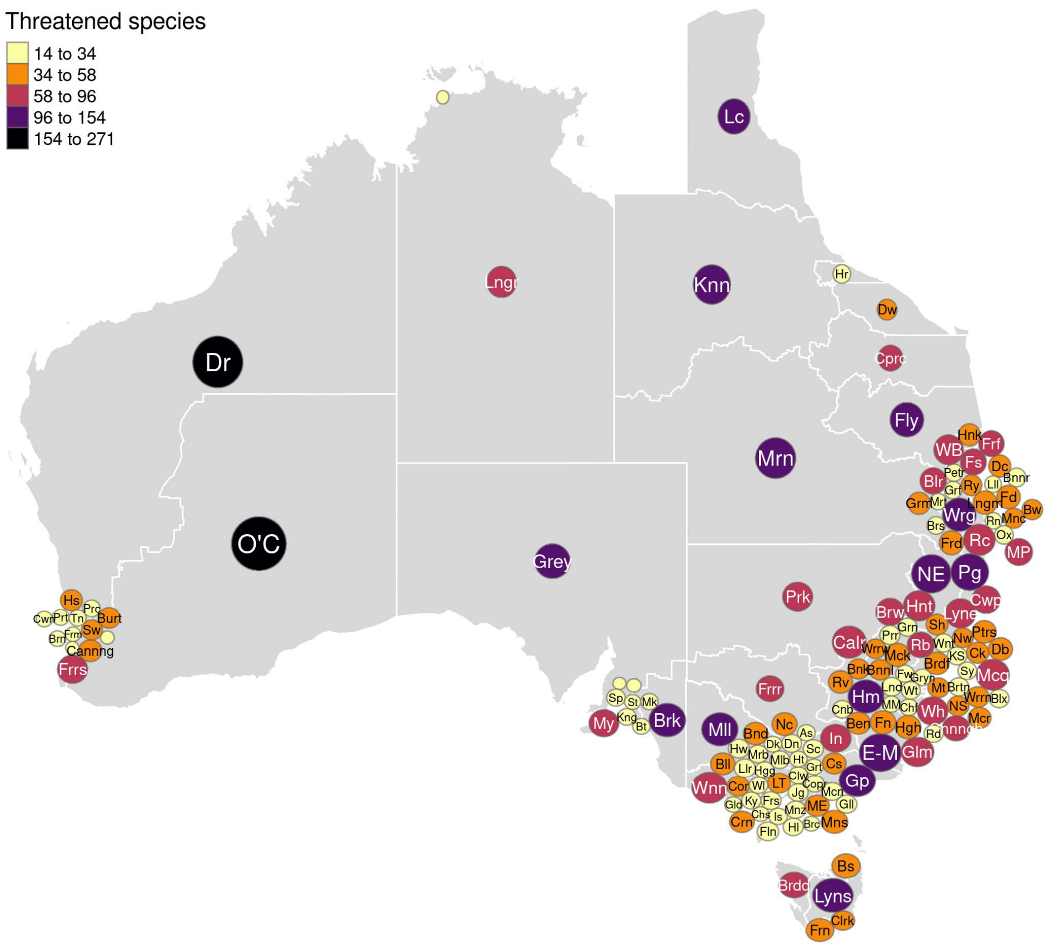
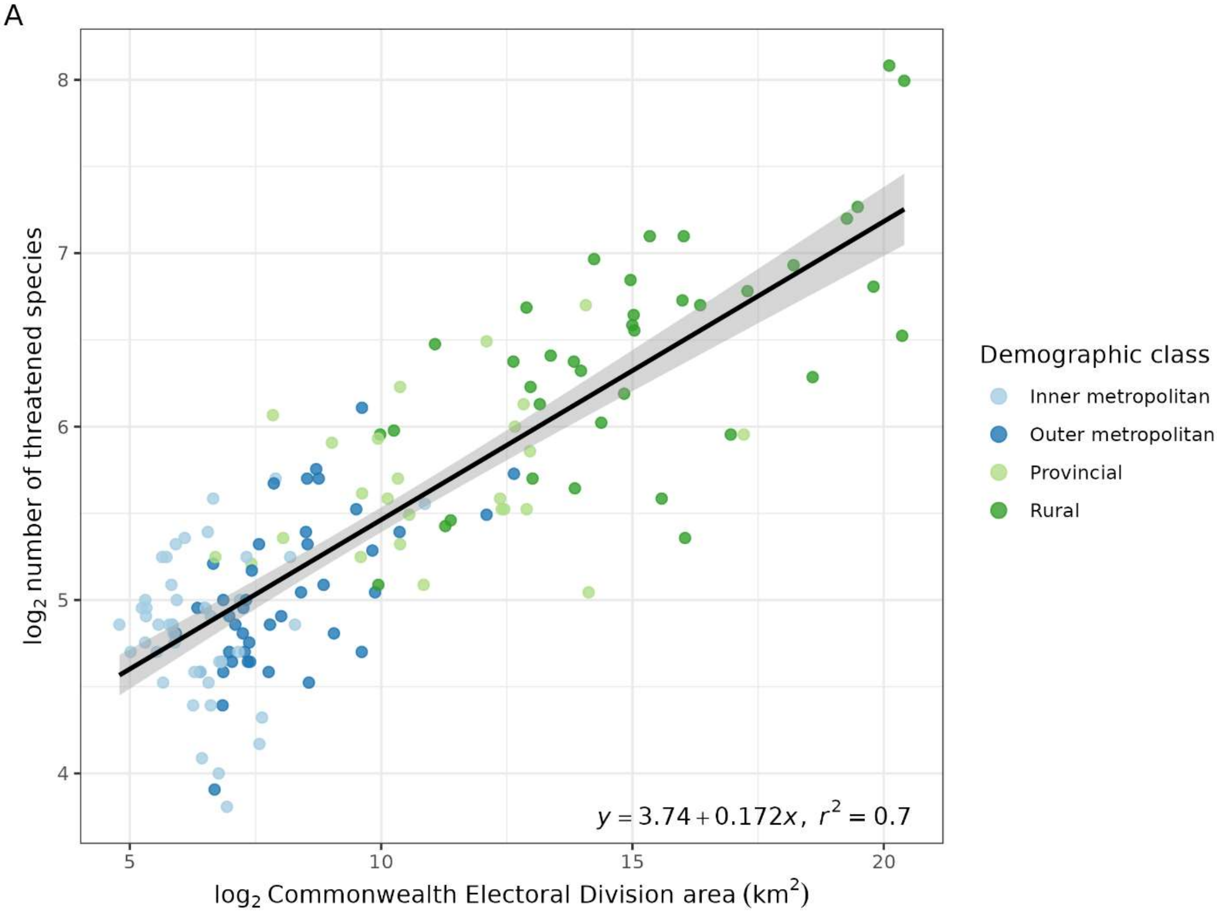


Figure 1. Non-overlapping circles (Dorling) cartogram of threatened species occurrence within the 151 Commonwealth Electoral Divisions (CEDs) and a map showing the geographical boundaries in the background. Bubbles correspond in colour and size to the number of threatened species found within the CED. Bubbles represent the geographic region of the CEDs and are arranged as close as possible to the original location of the CED. Heavy clustering of bubbles occurs in metropolitan areas (Brisbane, Sydney, Melbourne) where CEDs are too small to be represented alongside their rural counterparts on an untransformed scale. Labels are unique abbreviations of the CED name (Table S1 provides the exact number of threatened species and the full names of CEDs).

The number of threatened species present in a CED increased with its area (Fig. 2A), with size alone explaining 70% of the variation in numbers (Fig. 2A). The CEDs of O'Connor and Durack, both in Western Australia, have similar sizes to some other large remote CEDs (e.g., Lingiari and Grey), yet they have an unusually high number of threatened species, with 271 and 255 species, respectively (Table S1). Although demographic class (i.e., inner metropolitan, outer metropolitan, provincial, and rural) of CEDs provides an indication of population and land characteristics they are overlapping in areas and have an uneven distribution (Fig. 2B). There are fewer provincial CEDs (25) than the other three classes: inner metropolitan (45), outer metropolitan (43), and rural (38). The impact of CED area on number of threatened species differs between demographic classifications (Fig. 2B) with a significant positive relationship observed for outer metropolitan (r^2=0.35) and rural (r^2=0.43) classified CEDs but not for the other two classes. We found that there are 1,564 (95%) species that intersect with rural CEDs, 431 (26%) with provincial, 302 (18%) with outer metropolitan, 233 (14%) with inner metropolitan. The ten CEDs which intersect with the most threatened species are all classed as rural (cumulative total of 1134 out of 1651 threatened species, 69%).

A



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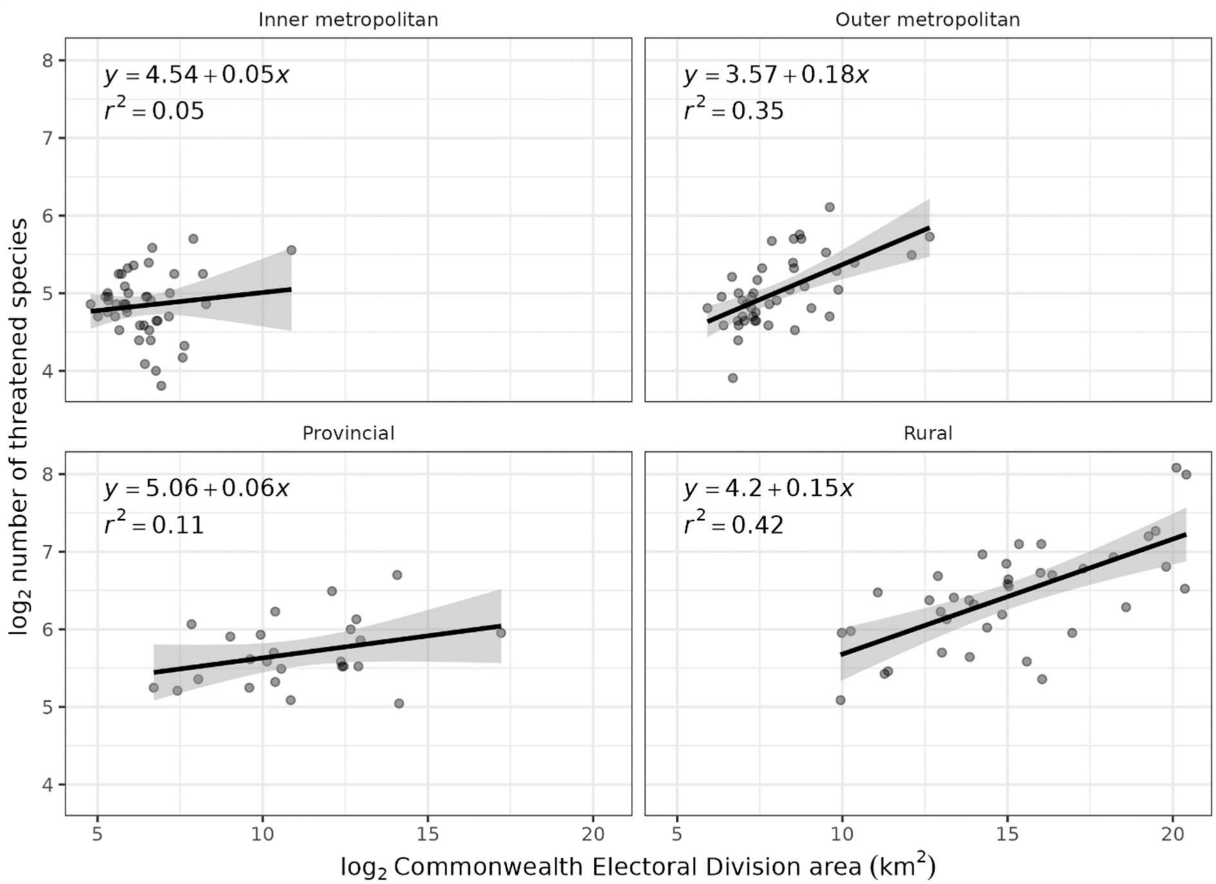

Figure 2A. Relationship between CED area (x axis, km^2, n=151, $\log_2$ scale) and number of threatened species (y axis, n=1651, $\log_2$ scale ($F = 349,\ P < .001,\ 95\%\ CI\ for\ \beta_1\ (3.55, 3.93)$). The plot shows CEDs (dots), demographic class of CED (colour), estimated mean (solid line), and 95% confidence interval (grey area). Figure 2B shows the same relationship and features except separated between the four demographic classifications: Inner metropolitan ($F = .647,\ P > .05, 95\%\ CI\ for\ \beta_1\ of\ (3.79, 5.3)$); outer metropolitan ($F = 21.9,\ P < .001, 95\%\ CI\ for\ \beta_1\ of\ (2.93, 4.2)$); provincial ($F = 2.64,\ P > .05, 95\%\ CI\ for\ \beta_1\ of\ (4.24, 5.88)$); rural ($F = 27.9,\ P < .001, 95\%\ CI\ for\ \beta_1\ of\ (3.32, 5.07)$). Only outer metropolitan and rural were statistically significant.

Single CED species

A total of 801 (49%) threatened species listed on the EPBC Act are confined to or intersect with a single CED (Fig. 3; Fig. 4). Of these ‘CED endemic’ species, 763 are within rural CEDs (Fig. 4), 26 in provincial CEDs, and 11 in outer metropolitan CEDs, and one in inner metropolitan CEDs. A total of 48 CEDs harbour ‘CED endemic’ species within their boundaries (Fig. 4). Of these 48 CEDs, 33 are rural, eight are provincial, six are outer metropolitan, and one is inner metropolitan.

Most CED endemic species have relatively small geographic distributions (Fig. 5). There are exceptions, including the Pilbara subspecies of the Olive Python (*Liasis olivaceus barroni*) and Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*), with considerable ranges (116,000 km^2, 77,600 km^2, respectively) but found in the large rural CED of Durack (WA).

The rural CED of O'Connor (WA), with 271 species, harbours the most 'CED endemics', including the Kyloring or Western Ground Parrot (*Pezoporus flaviventris*), the Arid Bronze Azure (*Ogyris subterrestris petrina*), and the Underground Orchid (*Rhizanthella gardneri*). The CEDs of Lyons (rural, Tasmania (TAS)) and Leichardt (rural, Queensland) are far smaller CEDs, yet they contain among the most endemics (Fig. 4, Table S1). Leichardt contains 14 EN endemics such as the Cape York Rock-Wallaby (*Petrogale coenensis*) and Whiskered Rein Orchid (*Habenaria maccraithii*). Franklin (6290 km^2), an outer metropolitan CED, has four endemics all of which are CR such as the Francistown Cave Cricket (*Micropathus kiernani*).

Species that cross multiple CEDs

A total of 544 (33%) threatened species intersect with two to four CEDs (Fig. 3, Table S2). These species tend to have small geographic distributions (Fig. 5) and are often found on coastal urban fringes (Fig. 1). For example, the Baw Baw Frog (*Philoria frosti*) occurs across two CEDs, Casey and Monash (Victoria (VIC)). The Western Swamp Tortoise (*Pseudemydura umbrina*) shares this electoral coverage, residing across Durack and Hasluck (WA). The range of the Mountain Pygmy-possum (*Burramys parvus*) covers Eden-Monaro (NSW), Gippsland (VIC), and Indi (VIC).

A total of 306 (18%) species cover > four CEDs such as the Golden Sun Moth (*Synemon plana*), which covers 34 CEDs (Fig. 3, Table S2). Some threatened species such as Australasian Bittern (*Botaurus poiciloptilus*) and Australian Painted Snipe (*Rostratula australis*) are distributed across 145 CEDs, the highest number of CEDs any Australian threatened species' covers. The mammal with the largest number of CEDs within its range (128 CEDs) is the Grey-headed Flying-fox (*Pteropus poliocephalus*). The Scrub Turpentine (*Rhodamnia rubescens*) is the flora with the most CED coverage at 65.

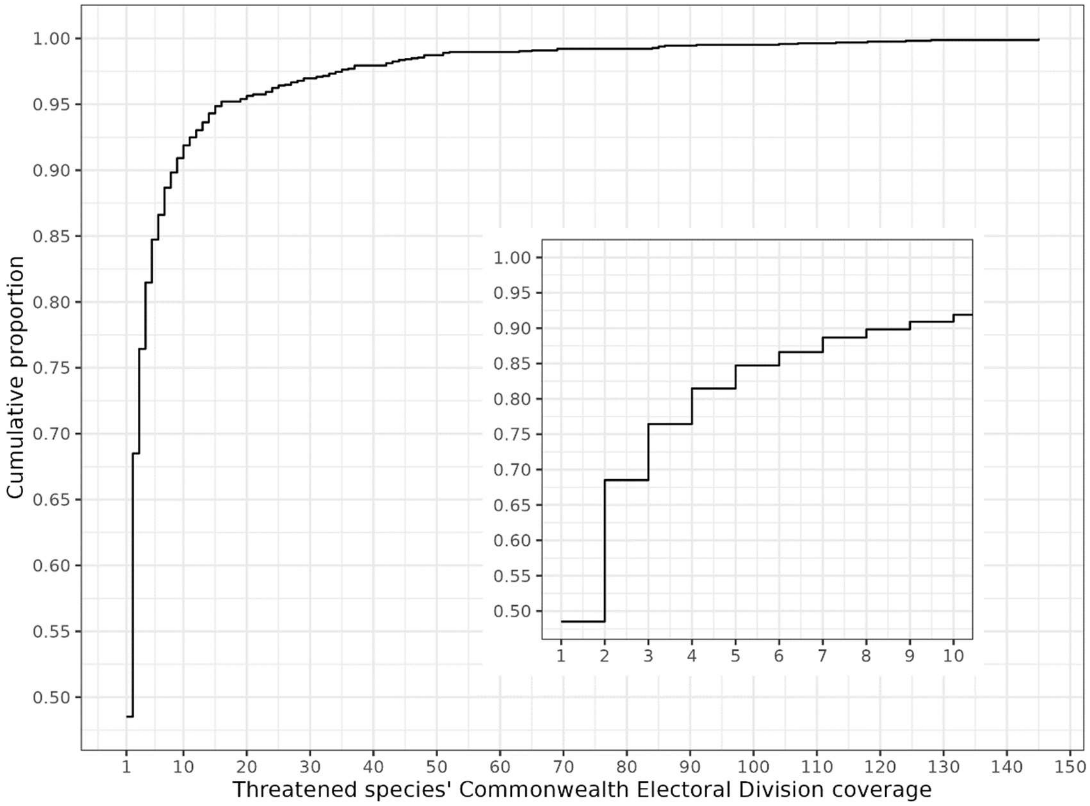

Figure 3. The cumulative proportion of threatened species (n=1651) coverage across CEDs (n=151). The inset is the zoomed proportion of species with fewer than or equal to 10 coverage (n=1517). Each species' CED coverage is the sum of distinct CED their range intersects with. Species that have greater than 10 coverage (n=134) are excluded from the inset graph but included in the overall proportion. The number of species found at each increment of possible electorate coverage (n = 151) were converted to proportions using the empirical cumulative distribution function to represent which proportion of species are at or below the given number of electorate coverage.

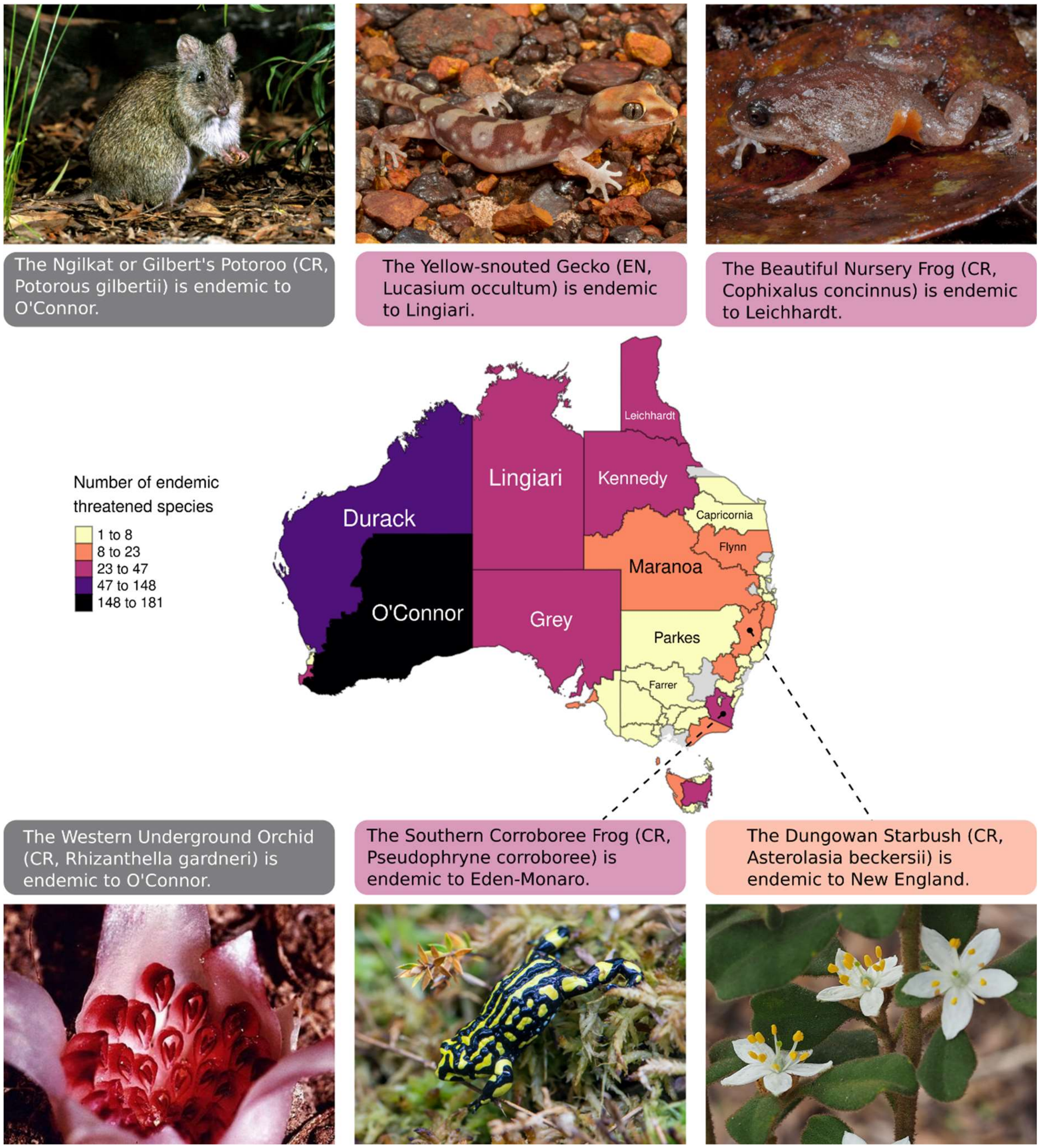

Figure 4. Locations of Commonwealth Electoral Divisions (CEDs) (n=48) that contain threatened species that are only found within their boundaries (CED endemics). Examples of some of these CED endemics and which CED they are located shown. VU, Vulnerable; EN, Endangered; CR, Critically Endangered. Image credit: *Potorous gilbertii* by Dick Walker (Gilbert's Potoroo Action Group), *Lucasium occultum* by Chris Jolly, *Cophixalus concinnus* by Anders Zimny, *Rhizanthella gardneri* by Jean and Fred Hort, *Pseudophryne corroboree* by John Spencer (NSW Department of Planning Environment), *Asterolasia beckersii* by Geoff Derrin.

Discussion

We found that every Australian CED contains at least 14 threatened species which provides an important opportunity for all Australian elected representatives and constituencies. Representatives could adopt a local leadership agenda for the species found within their CED, and constituents could encourage them to do so (Fig. 1). As there is variance in the numbers of threatened species found within each CED, representatives have differing levels of responsibility (Fig. 2). But many species are 'CED-endemics' (49%; Fig. 3) which makes local agendas of representative leadership an integral part of broader national effort for government-involved conservation action. These geographically unique species are likely to become extinct in the wild without the critically needed local action and leadership.

Whilst citizens, communities, and environmental non-governmental organisations have mustered substantial on-the-ground effort for many species across the world (Grace et al., 2021), transformative recovery is not surmountable without government action (Australian National Audit Office, 2022; Garnett et al., 2018; Samuel, 2020). Climate change and habitat-loss are examples of key threatening processes that with current levels of government action and support has meant species recovery has been incremental and oscillatory (Threats to Nature project, 2022). Thus, the opportunity for leadership from elected representatives to support threatened species conservation needs to focus on the policies that enable and encourage species recovery. In the contemporary Australian context, this could mean delivering EPBC Act reform that has been mapped out twice (Hawke, 2009; Samuel, 2020) and actively engaging on relevant legislation such as rejecting activities that threaten species' critical habitat (Reside et al., 2019).

Elected representatives influence the public debate around issues through discussion of their priorities in parliament or the media, often with a local agenda. Whilst representatives often advocate for broader social issues such as health care and educational infrastructure, local ownership of the biodiversity crisis is often neglected. The conservation community could aim to facilitate constituency members to communicate with their local representatives about a specific threatened species issue, thereby shaping sympathetic decision-makers to proactively engaging with the crisis and consequently delivering reform (Pitkin, 1972; Rose et al., 2018; Woinarski et al., 2017). Accountability institutions such as digital-native (e.g., social) and legacy media (e.g., print media) offer a means to reach constituency members and promote change to elected representatives (Hackett et al., 2017). By embracing efforts deployed in other disciplines such as public health and climate change in building public support and awareness (Appelgren & Jönsson, 2021; Ting et al., 2020), the conservation community could use data like that provided here to raise awareness of the plight of threatened species. Furthermore, the actions of a motivated representative to adopt the biodiversity crisis as a priority could encourage other less motivated and ideologically alike colleagues to adopt a similar approach by means of social contagion (Ognyanova, 2022).

Measurement of government activities provide an essential mechanism to further encourage political accountability in addressing the species extinction crisis (Doherty et al., 2018). Although this mostly occurs on international scales (Collen et al., 2009), there are new tools that enable within-country measurement that utilise the principles we employ here. These include indicators reflective of the policy and promises of elected representatives and their political affiliations such as the annual League of Conservation Voters Scorecard (League of Conservation Voters, 2022), aperiodic WWF Scorecard (World Wildlife Fund, 2016), and continual They Vote For You platform (They Vote For You, 2022) that aim to facilitate the constituency being more aware of government stances on environmental issues. These performance metrics and scorecards contribute the ability of constituents to hold representatives accountable (Pitkin, 1972), thereby working towards incentivising government action. As these feedback mechanisms mature, they may encourage the implementation of electoral systems that enshrine non-human representation in the process of governance (Burke & Fishel, 2020).

As a step towards encouraging stronger political action in overcoming the species extinction crisis, we showcase an approach for assessing geographical electoral systems against distributions of threatened species. We show that in Australia all federal elected representatives have threatened species within their CEDs, meaning there is an opportunity for representatives to adopt an active role in advocating for their locality. This analysis highlights a methodology that allows for the enumerating the species crisis to better understand the responsibility elected representatives have to their local region and constituents. Linking species distributions to political geography allows for an assessment of the complementary role that constituents, representatives, and advocacy organisations can play in elevating threatened species as a priority of government among representative democracies.

Supporting information

Table S1 (summary counts): Summary table of CED information and counts of species.
Table S2 (expanded summary): Summary table of individual species with CED information.

Acknowledgements and data

G.S.K and J.E.M.W conceived of and designed the research. G.S.K drafted the work. G.S.K, S.K, M.S.W and J.E.M.W. worked on acquisition, analysis, and interpretation of data. All authors contributed to the article with substantial revisions and approved the submitted version.

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Reference list

Appelgren, E., & Jönsson, A. M. (2021). Engaging Citizens for Climate Change—Challenges for Journalism. *Digital Journalism*, *9*(6), 755–772. https://doi.org/10.1080/21670811.2020.1827965

Australian Electoral Commission. (2022). *Federal electoral boundaries*. Commonwealth of Australia. https://www.aec.gov.au/Electorates/gis/gis_datadownload.htm

Australian National Audit Office. (2022). *Management of threatened species and ecological communities under the Environment Protection and Biodiversity Conservation Act 1999: Department of Agriculture, Water and the Environment*.

Brenton, S. (2010). *What lies beneath: The work of senators and members in the Australian Parliament*. Dept. of Parliamentary Services.

Burke, A., & Fishel, S. (2020). Across Species and Borders: Political Representation, Ecological Democracy and the Non-Human. In J. C. Pereira & A. Saramago (Eds.), *Non-Human Nature in World Politics: Theory and Practice* (pp. 33–52). Springer International Publishing. https://doi.org/10.1007/978-3-030-49496-4_3

Collen, B., Loh, J., Whitmee, S., McRAE, L., Amin, R., & Baillie, J. E. M. (2009). Monitoring Change in Vertebrate Abundance: The Living Planet Index. *Conservation Biology*, *23*(2), 317–327. https://doi.org/10.1111/j.1523-1739.2008.01117.x

Commonwealth of Australia. (2021). *Threatened species under the EPBC Act*. Department of Environment and Energy, Australian Government, Canberra, Australia. https://www.environment.gov.au/biodiversity/threatened/species

Creswell, I., Janke, T., & Johnston, E. (2021). *Australia State of the Environment 2021*. https://doi.org/10.26194/F1RH-7R05

Díaz, S., Zafra-Calvo, N., Purvis, A., Verburg, P. H., Obura, D., Leadley, P., Chaplin-Kramer, R., De Meester, L., Dulloo, E., Martín-López, B., Shaw, M. R., Visconti, P., Broadgate, W., Bruford, M. W., Burgess, N. D., Cavender- Bares, J., DeClerck, F., Fernández-Palacios, J. M., Garibaldi, L. A., … Zanne, A. E. (2020). Set ambitious goals for biodiversity and sustainability. *Science*, *370*(6515), 411–413. https://doi.org/10.1126/science.abe1530

Doherty, T. S., Bland, L. M., Bryan, B. A., Neale, T., Nicholson, E., Ritchie, E. G., & Driscoll, D. A. (2018). Expanding the Role of Targets in Conservation Policy. *Trends in Ecology & Evolution*, *33*(11), 809–812. https://doi.org/10.1016/j.tree.2018.08.014

Dorling, D. (1996). *Area cartograms: Their use and creation, concepts and techniques in modern geography* (Vol. 59). Institute of British Geographers.

Garnett, S. T., Woinarski, J., Lindenmayer, D., & Latch, P. (2018). Recovering Australian Threatened Species: A Book of Hope. In *Recovering Australian Threatened Species*. CSIRO Publishing.

Grace, M. K., Akçakaya, H. R., Bennett, E. L., Brooks, T. M., Heath, A., Hedges, S., Hilton-Taylor, C., Hoffmann, M., Hochkirch, A., Jenkins, R., Keith, D. A., Long, B., Mallon, D. P., Meijaard, E., Milner-Gulland, E. j., Rodriguez, J. P., Stephenson, P. j., Stuart, S. N., Young, R. P., … Young, S. (2021). Testing a global standard for quantifying species recovery and assessing conservation impact. *Conservation Biology*, *35*(6), 1833–1849. https://doi.org/10.1111/cobi.13756

Hackett, R. A., Forde, S., Gunster, S., & Foxwell-Norton, K. (2017). *Journalism and Climate Crisis: Public Engagement, Media Alternatives*. Routledge. https://research-repository.griffith.edu.au/handle/10072/338900

Hawke, A. (2009). *Report of the Independent Review of the Environment Protection and Biodiversity Conservation Act 1999*.

IPBES. (2019). *Summary for policymakers of the global assessment report on biodiversity and ecosystem services*. 60. https://doi.org/10.5281/zenodo.3553579

Jeworutzki, S. (2020). *cartogram: Create Cartograms with R*. https://CRAN.R-project.org/package=cartogram

League of Conservation Voters. (2022). *National Environmental Scorecard*. https://lcv.org/national-environmental-scorecard/

Lloyd, T. J., Fuller, R. A., Oliver, J. L., Tulloch, A. I., Barnes, M., & Steven, R. (2020). Estimating the spatial coverage of citizen science for monitoring threatened species. *Global Ecology and Conservation*, *23*, e01048. https://doi.org/10.1016/j.gecco.2020.e01048

Matthews, T. J., Triantis, K. A., Whittaker, R. J., & Guilhaumon, F. (2019). sars: An R package for fitting, evaluating and comparing species–area relationship models. *Ecography*, *42*(8), 1446–1455. https://doi.org/10.1111/ecog.04271

Ognyanova, K. (2022). Contagious Politics: Tie Strength and the Spread of Political Knowledge. *Communication Research*, *49*(1), 116–138. https://doi.org/10.1177/0093650220924179

Parliament of Australia. (2018). Electoral divisions. In *House of Representatives Practice* (Australia; 7th ed.). Department of the House of Representatives. https://www.aph.gov.au/About_Parliament/House_of_Representatives/Powers_practice_and_procedure/Practice7/HTML/Chapter3/Electoral_divisions

Pebesma, E. (2018). Simple Features for R: Standardized Support for Spatial Vector Data. *The R Journal*, *10*(1), 439–446.

Pitkin, H. F. (1972). *The Concept of Representation*.

R Core Team. (2021). *R: A language and environment for statistical computing*. Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org/

Reside, A. E., Cosgrove, A. J., Pointon, R., Trezise, J., Watson, J. E. M., & Maron, M. (2019). How to send a finch extinct. *Environmental Science & Policy*, *94*, 163–173. https://doi.org/10.1016/j.envsci.2019.01.005

Rose, D. C., Sutherland, W. J., Amano, T., González-Varo, J. P., Robertson, R. J., Simmons, B. I., Wauchope, H. S., Kovacs, E., Durán, A. P., Vadrot, A. B. M., Wu, W., Dias, M. P., Di Fonzo, M. M. I., Ivory, S., Norris, L., Nunes, M. H., Nyumba, T. O., Steiner, N., Vickery, J., & Mukherjee, N. (2018). The major barriers to evidence-informed conservation policy and possible solutions. *Conservation Letters*, *11*(5), e12564. https://doi.org/10.1111/conl.12564

Samuel, G. J. (2020). *Independent review of the EPBC Act: Final report*.

Sutherland, W. J., Dicks, L. V., Ockendon, N., Petrovan, S. O., & Smith, R. K. (2018). *What Works in Conservation: 2018*. Open Book Publishers. https://doi.org/10.11647/obp.0131

Tennekes, M. (2018). tmap: Thematic Maps in R. *Journal of Statistical Software*, *84*, 1–39. https://doi.org/10.18637/jss.v084.i06

They Vote For You. (2022). *How does your MP vote on the issues that matter to you?* https://theyvoteforyou.org.au/

Threats to Nature project. (2022). *Averting Extinctions: The case for strengthening Australia's threat abatement system*. Invasive Species Council, Bush Heritage Australia, BirdLife Australia, the Australian Land Conservation Alliance and Humane Society Internationa.

Ting, D. S. W., Carin, L., Dzau, V., & Wong, T. Y. (2020). Digital technology and COVID-19. *Nature Medicine*, *26*(4), Article 4. https://doi.org/10.1038/s41591-020-0824-5

Toomey, A. H., Knight, A. T., & Barlow, J. (2017). Navigating the Space between Research and Implementation in Conservation. *Conservation Letters*, *10*(5), 619–625. https://doi.org/10.1111/conl.12315

Urbinati, N., & Warren, M. E. (2008). The Concept of Representation in Contemporary Democratic Theory. *Annual Review of Political Science*, *11*(1), 387–412. https://doi.org/10.1146/annurev.polisci.11.053006.190533

Ward, M., Carwardine, J., Yong, C. J., Watson, J. E. M., Silcock, J., Taylor, G. S., Lintermans, M., Gillespie, G. R., Garnett, S. T., Woinarski, J., Tingley, R., Fensham, R. J., Hoskin, C. J., Hines, H. B., Roberts, J. D., Kennard, M. J., Harvey, M. S., Chapple, D. G., & Reside, A. E. (2021). A national-scale dataset for threats impacting Australia's imperiled flora and fauna. *Ecology and Evolution*, *n/a*(n/a). https://doi.org/10.1002/ece3.7920

Watson, J. E. M., Simmonds, J. S., Narain, D., Ward, M., Maron, M., & Maxwell, S. L. (2021). Talk is cheap: Nations must act now to achieve long-term ambitions for biodiversity. *One Earth*, *4*(7), 897–900. https://doi.org/10.1016/j.oneear.2021.06.012

Wickham, H., Averick, M., Bryan, J., Chang, W., McGowan, L. D., François, R., Grolemund, G., Hayes, A., Henry, L., Hester, J., Kuhn, M., Pedersen, T. L., Miller, E., Bache, S. M., Müller, K., Ooms, J., Robinson, D., Seidel, D. P., Spinu, V., … Yutani, H. (2019). Welcome to the Tidyverse. *Journal of Open Source Software*, *4*(43), 1686. https://doi.org/10.21105/joss.01686

Woinarski, J. C. Z., Garnett, S. T., Legge, S. M., & Lindenmayer, D. B. (2017). The contribution of policy, law, management, research, and advocacy failings to the recent extinctions of three Australian vertebrate species. *Conservation Biology*, *31*(1), 13–23. https://doi.org/10.1111/cobi.12852

World Wildlife Fund. (2016). *Environment Scorecard 2016*. http://scorecard.wwf.org.au/