Title: Comparing screening outcomes of national and global biodiversity datasets for private sector nature-related disclosures

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Comparing screening outcomes of national and global biodiversity datasets for private sector nature-related disclosures

Abstract

In response to demand for better biodiversity stewardship from the private sector, frameworks such as the Taskforce on Nature-related Financial Disclosures (TNFD) have been developed to help companies assess, manage and disclose their nature-related impacts, dependencies, risks and opportunities. A key initial screening step is to identify operations in ecologically sensitive areas, often done using global datasets that are readily available and globally consistent, but may be less accurate that national data informed by local expertise and conditions. In this study, we explore the implications of using global or national biodiversity datasets for identifying ecologically sensitive sites at large scales, using South Africa as a case study. We simulated a screening process by generating ‘sites’ through stratified random sampling, and screening these based on three TNFD criteria for ecologically sensitive sites: biodiversity importance, high ecosystem integrity, and rapid decline in ecosystem integrity. We compared results from multiple global and national datasets, calculating omission errors, where global datasets omit sites identified by national data, and commission errors, where global datasets flag sites as sensitive but national data do not. We found global datasets missed between over 39% of areas important for biodiversity, as identified by national datasets. This risks ongoing biodiversity loss, because sites omitted at early screening stages are unlikely to have resources allocated for conservation or restoration. Our findings suggest a cautious use of global datasets, with an emphasis on encouraging the use of national datasets, particularly when fine-scale, field-validated, and frequently updated data are available.

Introduction

Biodiversity is undergoing unprecedented global decline, with more than one million species at risk of extinction within decades (Brondízio *et al.* 2019; Hochkirch *et al.* 2023). The Kunming-Montreal Global Biodiversity Framework, under the UN Convention on Biological Diversity, sets goals and targets for efforts to halt and reverse biodiversity loss (CBD 2022). Target 15 of the Framework recognises the role of the private sector, requiring that companies and financial institutions assess and disclose their biodiversity impacts, and encouraging actions with positive outcomes for nature and society. Private sector-led frameworks, such as the Taskforce on Nature-related Financial Disclosures (TNFD), are being developed to address these needs. Notably, frameworks led by the private sector can encourage integration of nature-related considerations into decision-making and translate high-level goals into meaningful actions for biodiversity and sustainability (Milner-Gulland *et al.* 2021).

The initial phases of nature-related assessments include understanding a company’s interface and potential impacts on biodiversity. This includes screening sites that a company operates in, or that are part of their supply chain, based on whether they are in ecologically sensitive locations. To do that, numerous tools and datasets have been developed (Bebbington *et al.* 2024; Hawkins *et al.* 2024; UNEP FI 2023), yet because of the complexity of biodiversity, there is a lack of consensus among scientists and policy makers over the utility of different datasets (Irvine-Broque & Dempsey 2023; Mair *et al.* 2024; Watermeyer *et al.* 2021; Mendez Angarita *et al.* 2025).

Datasets available at a global scale are often used for initial assessments, but the use of global datasets involves uncertainties and risks created by low-quality data, outdated data, and inappropriate spatial scale (Harrer *et al*. 2024; TNFD 2023a). If biodiversity metrics underpinned by global data are used without appropriately dealing with risks and uncertainties, metrics with substantial flaws could become entrenched (Layman *et al.* 2024). National or local data, on the other hand, are used less often by the private sector because they are underpinned by a variety of methods and can be more difficult to compare between countries and harder to access. Nevertheless, there is some evidence that national data are more frequently updated and more accurately represent the distribution of species and ecosystems (Burgess *et al.* 2024). To date, evaluations of global and national datasets used for nature-related disclosure have been predominantly qualitative and theoretical (CBD 2022; Nicholson *et al.* 2021). There is a critical gap in quantitative and spatial analysis comparing datasets at different scales.

Here, we explore the implications of using global or national biodiversity datasets for identifying ecologically sensitive sites at large scales, using South Africa as a case study. We focussed on two biomes in South Africa's Cape Floristic Region – Fynbos and Albany Thicket – that are globally recognised for diverse plant species and high levels of endemism (Claudino-Sales 2019). The South African Government has developed comprehensive biodiversity databases through processes such as the National Biodiversity Assessment conducted approximately every seven years (SANBI 2018), and a range of taxon specific and provincial biodiversity monitoring initiatives. National data were identified through literature searches and consultation with the South African National Biodiversity Institute (SANBI), and included national protected areas, Critical Biodiversity Areas, and threatened ecosystems identified in the Red List of Ecosystems (Table 1). We selected global data following TNFD's recommendation (TNFD, 2023a), all globally complete and consistent (in this case, covering all terrestrial ecosystems using the same methodology). They included the World Database on Protected Areas (WDPA), Key Biodiversity Areas (KBAs), and the Species Threat Abatement and Restoration (STAR) metric for biodiversity importance, and the Ecosystem Integrity Index (EII), the Mean Species Abundance (MSA), and the Human Modification Index (HMI) for ecosystem integrity (Table 1).

We simulated a screening process by generating 'sites' through stratified random sampling, and screening these for ecologically sensitive sites based on criteria in TNFD (TNFD 2023a) – biodiversity importance, high ecosystem integrity and rapid decline in ecosystem integrity. We compared results from global and national data, calculating omission errors, where global datasets omit ecologically sensitive sites identified by national data, because erroneously excluding sites from further assessments of impacts, opportunities and risks likely harms biodiversity. Conversely, commission errors, where global datasets flag sites as sensitive but national data do not, are of lower concern in the context of biodiversity loss. Although commission errors may increase costs via additional analyses, this error type can more easily be dealt with in secondary stages of analyses. We also examined the sensitivity of screening outcomes to thresholds for 'high' ecosystem integrity, and compared global integrity data with national condition data to examine sources of difference.

Methods

Study region

Fynbos biome spans 54,918 km^2 in the Mediterranean-type climate of the southwestern and southern Cape. Fynbos, meaning 'fine-leaved bush', comprises evergreen sclerophyllous shrubland characterized by dominant proteoid, ericoid, and restioid vegetation (Finch & Meadows 2019). 59 out of 120 ecosystem types within this biome are classified as threatened, making it the most threatened biome in South Africa (Skowno *et al.* 2021; Skowno & Monyeki 2021). Albany Thicket biome features dense, semi-succulent woody vegetation with thorns, reaching heights of 2-3 meters (Esler & Archer 2018). This biome spans 31,988 km^2 and forms the southwestern component of the Maputaland-Pondoland-Albany biodiversity hotspot (SANBI 2010). The Albany Thicket biome has six out of a total of 44 ecosystems listed as threatened (Skowno *et al.* 2021; Skowno & Monyeki 2021).

Global datasets

The global datasets used in analyses of biodiversity importance included the World Database on Protected Areas (WDPA), Key Biodiversity Areas (KBAs), and the Species Threat Abatement and Restoration (STAR) metric for biodiversity importance (STARt and STARr) (Table 1). These datasets inform standards used in global initiatives, such as the Global Reporting Initiative Standards and IFC Performance Standard 6, and are available through the Integrated Biodiversity Assessment Tool (IBAT).

Ecosystem integrity is defined as the extent to which the composition, structure and function of an ecosystem falls within the natural range of variation (Nicholson *et al.* 2020). Univariate and multivariate measures for ecosystem integrity have been developed at a range of scales (Nicholson *et al.* 2021). These metrics measure the state of ecosystem characteristics directly, or indirectly measure ecosystems with the use of proxies, including pressures and threats on or to biodiversity. Existing metrics often measure ecosystem quality relative to a reference condition with a scale between 0 (entirely destroyed) and we (the reference level) (TNFD, 2023a). Following the TNFD recommendations and literature searches, we selected the Ecosystem Integrity Index (EII), the Mean Species Abundance (MSA), and the Human Modification Index (HMI) for ecosystem integrity (Table 1) as the global datasets for identifying areas of high ecosystem integrity.

Table 1. Global and national datasets for assessing ecologically sensitive locations based on biodiversity importance and high ecosystem integrity

Criteria	Datasets	Data specification Type	Resolution	Threshold for screening	Description	Source
Biodiversity Importance	***Global***					
	Word Database on Protected Area (WDPA)	Categorical (2 classes)	varying (at finest 2 m)	all	Global database of marine and terrestrial protected areas, managed by the UN Environment Programme World Conservation Monitoring Centre (UNEP-WCMC)	UNEP-WCMC and IUCN (2023)
	Key Biodiversity Areas (KBAs)	Categorical (2 classes)	varying (at finest 2 m)	all	KBAs: sites contributing significantly to the global persistence of biodiversity identified using set of criteria and categories (IUCN, 2016), managed by the KBAs partnership.	BirdLife International (2023)
	Threat abatement STAR (STARt) Restoration STAR (STARr)	Continuous/ 0 (low) - 1,000 (high)	5 km	>= 1.0	Quantifies contributions from abating threats (STARt) and restoring habitats (STARr) to reducing extinction risk for terrestrial amphibians, birds and mammals. Derived from IUCN Red List of Species data.	Mair *et al.* (2021)
	National					
	Protected Area (PA)	Categorical (2 classes)	50 m	all	Officially designated or acknowledged PAs under the National Environmental Management: Protected Areas Act in South Africa, encompassing National Parks, Nature Reserves, Protected Environments, and World Heritage Sites.	SANBI (2017)
	Critical Biodiversity Areas (CBA)	Categorical (2 classes)	50 m	all	South Africa's terrestrial, freshwater and estuarine ecosystems that are critical for conserving biodiversity, based on threatened species habitat and threatened ecosystems (CR and EN) in good ecological condition. Used for land-use planning and decision-making.	SANBI (2017)
	Red List of Ecosystem (RLE)	Categorical (5 classes)	30 m	CR and EN	IUCN's global standard for ecosystem risk assessment (IUCN 2024). South Africa assessed 456 terrestrial ecosystems as part of its National Biodiversity assessment in 2018 (Botts *et al*. 2020).	Skowno and Monyeki (2021)
High Ecosystem Integrity	***Global***					
	Ecosystem Integrity Index (EII)	Continuous/ 0 (low)– 1 (high)	1 km	>= 0.7	A composite metric to measure integrity of terrestrial ecosystems globally at 1km^2 resolution against a natural baseline, on a scale of 0 to 1 (low to high), based on three layers representing ecosystem structure, composition and function.	Hill *et al.* (2023)
	Mean Species Abundance (MSA)	Continuous/ 0 (low)– 1 (high)	300 m	>= 0.56	Estimates change average abundance of species based on six pressures, relative to a natural baseline, using the GLOBIO model; scales from 0 to 1 (low to high), with a spatial resolution of 10 arc-seconds.	Schipper *et al.* (2019)
	Human Modification Index (HMI)	Continuous/ 0 (low)– 1 (high)	1 km	=< 0.1	A composite metric to measure ecological condition of lands based on the spatial extent and intensity of human activities, from 13 primary land use pressures and values range from 0 to 1 (low to high).	Kennedy *et al.* (2019)
	National					
	Ecological condition	Categorical (4 classes)	30 m	Natural	Estimated using land cover change with supplementary data, such as field validation and expert judgement. SANBI used existing national data such as Pence (2017) and Lloyd *et al* (2002) as the source of the condition data. Classes: Natural, moderately degraded, severely degraded, and irreversibly modified.	SANBI (2017)
Rapid Decline in Ecosystem Integrity	***National***					
	RLE A2b sub-criteria	Categorical (5 classes)	30 m	CR, EN, and VU	Using RLE sub-criterion 2a: reduction in distribution over a 50-year period, including past, present and future. South Africa used the absolute rate of decline in natural habitat between 1990 and 2018 to project the reduction in ecosystem extent between 1990 and 2040 (Skowno & Monyeki 2021).	Skowno and Monyeki (2021)

National datasets

The national datasets for biodiversity importance were identified using the South Africa's National Biodiversity Offset Guideline, issued by the South African Government's Department of Forestry, Fisheries and the Environment (2023). This guideline sets out several categories of biodiversity importance, and we used datasets from 'irreplaceable biodiversity' and 'biodiversity of major potential concern', which are defined by high threat status or irreversible and irreplaceable loss of ecosystems or species. Through this process of engagement with SANBI, we identified the datasets of protected area, the Critical Biodiversity Area and ecosystems identified as CR and EN based on national assessments using the criteria and categories of the IUCN Red List of Ecosystems. The Red List of Ecosystems, IUCN's global standard for ecosystem risk assessment, provides a comprehensive framework for evaluating the risk of ecosystem collapse based on changes in distribution and integrity (Keith et al., 2013; IUCN, 2024). It is a headline indicator for the Kunming-Montreal Global Biodiversity Framework (Nicholson et al. 2024). South Africa integrated the Red List of Ecosystems standard as a legalised ecosystem assessment tool under the Biodiversity Act (Skowno & Monyeki 2021). Data on South Africa's threatened ecosystems has been used in other analyses of nature-related risks (Hadji-Lazaro *et al*. 2025).

For the national data for areas of high ecosystem integrity, we used ecological condition data developed by SANBI. The data was primarily developed through the land cover change analysis with supplementary data such as field validation and expert judgement. This ecological condition data is used by the South African Government in their National Biodiversity Assessment (SANBI, 2018) a state of biodiversity report, by provincial and metropolitan governments when Critically Biodiversity Area and in the Red List of Ecosystems assessments.

For the national data for rapid decline of ecosystem integrity, we applied a sub-criterion of the Red List of Ecosystems, reduced geographical distribution in extent over a 50-year period including past, present and future. This particular sub-criterion examines the extent to which an ecosystem's area has declined and is expected to decline, thereby indicating a deterioration in its overall health and functionality. South Africa calculated the rate based on the absolute rate of decline in natural habitat between 1990 and 2018, then, estimated the reduction in ecosystem extent between 1990 and 2040.

Sampling sites to replicate a company's screening process

We used stratified random sampling to select sample points within Fynbos and Albany Thicket. These points enabled us to test a streamlined version of screening, representing how companies assess sites related to direct operations, supply chains, and financial activities. A total of 1,633 points in Fynbos and 726 points in Albany Thicket were randomly selected, ensuring a minimum distance of 5 km between points, and a sample size of at least one point per 50 km^2 of the original extent of ecosystems in each biome before habitat loss (Skowno & Monyeki 2021). Of these 2,359 points, 1,771 were in extant 'natural' vegetation (1,126 in Fynbos and 645 in Albany Thicket), and 588 were in 'anthropogenic' ecosystem types such as agricultural areas (507 in Fynbos and 81 in Albany Thicket). QGIS (version 3.22.16) was used for spatial sampling.

Assessing biodiversity importance and ecosystems integrity in global and national datasets

We assessed whether each point met the criteria of biodiversity importance and high ecosystem integrity using both global and national datasets (listed in Table 1). The results of this categorisation were organised into a confusion matrix to visualise agreement and disagreement between the global and national dataset classifications. The confusion matrix summarised four outcomes: agreed inclusion (green), agreed exclusion (blue), omission errors (red), and commission errors (orange) (Figures 1 and 3). Omission errors, where global data failed to identify sensitive sites that were identified as sensitive by national data, are particularly important in the context of this study because they highlight the risk of a company missing areas of high biodiversity value from business decisions. We also assessed whether points met the criteria for biodiversity importance AND high ecosystem integrity (that is, where areas are identified by both criteria).

Additional analysis of rapid decline of ecosystem integrity for national datasets

Rapid decline of ecosystem integrity is an additional criterion defined by TNFD to highlight where urgent actions are needed to mitigate land use pressures. Using a sub-criterion of the Red List of Ecosystems, we analysed which of the randomly sampled sites met the criterion of rapid decline of ecosystem integrity, defined by their presence in ecosystems classified as Critically Endangered (CR), Endangered (EN) and Vulnerable (VU).

Sensitivity analysis of screening outcomes to threshold settings for high ecosystem integrity

The screening analyses for ecosystem integrity require a threshold be defined above which sites are classified as ‘high ecosystem integrity’, for global and national data. The threshold value, applied to a continuous metric, can influence screening outcomes. To examine the sensitivity of outcomes to this decision, we first defined thresholds for high ecosystem integrity based on published recommendations from the index authors and the broader literature (Table 1). We then conducted a sensitivity analysis on the Ecosystem Integrity Index (EII), the Mean Species Abundance (MSA), and the Human Modification Index (HMI) by varying the thresholds for inclusion as high ecosystem integrity areas, with threshold values ranging from 0.6 to 0.9 at 0.1 increments (i.e. four thresholds).

Analysis on national classifications of ecological condition with global integrity datasets

We conducted further analysis to examine the relationships between national classifications of ecological condition status and global integrity datasets (EII, MSA and HMI), to assess the accuracy and limitations of each data. We applied the three national classes; natural, moderately degraded, severely degraded/irreversibly modified, then analysed the distribution of global datasets at each class.

Results

Screening areas for biodiversity importance using global and national data

Screening for areas of biodiversity importance revealed that global datasets had high omission errors, where sites identified as important based on national data were overlooked by global data (Fig. 1b, Fig. 1d). Sites identified by global datasets, based on combined use of global biodiversity importance data failed to capture 39.1% of the areas of biodiversity importance identified by the national datasets for Fynbos, and 57.6% for Albany Thicket. Particularly high commission errors, 40.9% of the area excluded by the national datasets as having high biodiversity value, were found in Fynbos.

Screening results varied depending on the datasets used and the biome. In Fynbos, areas of agreed biodiversity importance based on national data and global KBAs were 17.1%, and for WPDA slightly higher at 22%. Whereas in Albany Thicket the proportion of agreed inclusion for KBAs was 14.3%, and only 6.6% for WDPA. STARr and STARt had the highest proportions of omission errors in both biomes, implying limited coverage of nationally designated biodiversity important areas.

Screening areas for high integrity using global and national data

Of areas identified as high ecosystem integrity by national datasets, 89.1% of samples in Fynbos and 90.9% in Albany Thicket were also classified as high ecosystem integrity when using all the global integrity dataset (Fig. 1f, Fig. 1h). This result was primarily driven by EII. Screening by EII in Albany Thicket also showed the high commission errors: 80.9% of areas mapped as low ecosystem condition by national dataset were identified as high integrity by EII. There was a particularly high risk of omitting areas of high integrity (in 'natural condition') based on national data when using either MSA or HMI only. The proportions of agreed inclusion were only 32.3% in Fynbos and 15.4% in Albany Thicket for MSA, and only 22.8% in Fynbos and 11.8% in Albany Thicket for HMI.

When biodiversity importance *and* ecosystem integrity were applied together, omission errors from global datasets increased. When both criteria were considered, global datasets omitted 42.8% of the area identified by the national datasets for Fynbos and 58.5% for Albany Thicket. These results highlight lower proportions of agreed inclusion when the two criteria were applied together than as single criteria.

Assessment of rapid decline of ecosystem integrity for national datasets

In Fynbos, 23.6% sites were classified as undergoing rapid decline in ecosystem integrity, based on high risk (CR, EN, and VU) under criterion A2b of the Red List of Ecosystems: recent past, present and future reductions in distribution (Keith *et al.* 2013). Rapid decline in ecosystem integrity is a TNFD criterion for ecologically sensitive sites that is currently not met by any global datasets appropriate for South Africa. 62 sites met all three criteria of high biodiversity importance, high ecosystem integrity, rapid decline of ecosystem integrity. In contrast, only four sites met the criterion of rapid decline of ecosystem integrity in Albany Thicket, one of which overlapped with other two criteria (Fig. 2).

Examination of threshold settings for assessing high ecosystem integrity

Screening outcomes were sensitive to the thresholds for high ecological integrity across the global integrity datasets (EII, MSA and HMI). Omission errors decreased as the threshold was lowered (i.e. becoming more inclusive of lower integrity sites), while commission errors increased. Sensitivity analysis of EII showed that thresholds above 0.6 resulted in the highest proportions of agreed inclusion, 62.5% for Fynbos and 66.4% for Albany Thicket with the lowest omission errors, traded off against an increase in commission errors (Fig. 3b). A threshold of above 0.6 reduced omission errors from 11% (threshold of above 0.7) to 4.5% for Fynbos and from 7.3% (threshold of above 0.7) to 3.3% for Albany Thicket. However, commission errors increased notably in Albany Thicket. The analysis of HMI showed a similar trend to EII. The thresholds below 0.2 had the highest agreed inclusion proportions, 51.2% for Fynbos and 56.5% for Albany Thicket though high commission errors were noted (20.2%) (Fig. 3f). For MSA, in contrast to EII, HMI, and national datasets, Fynbos had higher mean integrity (0.46 ± 0.27) compared to Albany Thicket (mean of 0.35 ± 0.22). The distribution of MSA data across the sample sites was bimodal, with one cluster concentrated between 0.2 and 0.4 and another between 0.7 and 0.85; therefore, the screening results were largely insensitive to thresholds of 0.8, 0.7, and 0.57 (Fig. 3d).

Comparing national data on ecological condition with global integrity datasets

Global integrity datasets had limited ability to distinguish between national condition categories, particularly in moderately degraded areas (Fig. 4). EII and HMI demonstrated better accuracy in distinguishing natural conditions from urban development or other anthropogenic land uses, resulting in more accurate screening results in Fynbos than in Albany Thicket, where the mean EII values for moderate degraded areas was higher than 'natural' areas (Fig. 4b). This discrepancy may be partly due to the different proportions of moderately degraded samples: only 2% in Fynbos compared to 19% in Albany Thicket where overstock of livestock is the primary degradation driver. For HMI, where higher values indicate greater land use pressure and thus lower integrity, Albany Thicket had lower mean HMI values for moderately degraded samples (0.13 ± 0.07) compared to natural status (0.16 ± 0.10) (Fig. 4f). MSA showed two distinct clusters in both biomes, resulting in particularly high omission errors (natural status samples classified as lower MSA) (Fig. 4c and 4d).

Discussion

Current guidelines for private-sector screening of ecologically sensitive locations recommend a range of global datasets (TNFD, 2023a). Our analysis demonstrates that the choice of datasets affects screening outcomes substantially, and reveals inconsistencies between global and national datasets. In particularly, we found that omission errors were common, which is important because when analyses based on global datasets fail to identify areas of national importance it is likely that biodiversity will continue to decline. In South Africa, where national datasets are tied to regulation for protection and offsetting, such errors may undermine and lead to conflict with national regulations (Botts *et al.* 2020). A precautionary approach is crucial to ensure that relevant data, whether global or national, is not ignored or cherry-picked to produce results that are convenient for companies.

Our spatial analyses highlighted that using global datasets for screening resulted in high omission errors, especially when considering biodiversity importance on its own and when biodiversity importance was considered alongside ecosystem integrity. Omission errors result in the exclusion from the subsequent phases of TNFD's LEAP approach (comprising Evaluate, Assess, and Prepare), which ultimately could contribute to ongoing biodiversity loss due to limited resource allocations for conservation and ecosystem restoration efforts at omitted sites. These findings indicate a major limitation in the effectiveness of approaches that rely on global datasets only, which are being used by companies to assess nature-related risks.

National and global assessments often provide different types of data for different purposes (Nicholson *et al.* 2024; Raimondo *et al.* 2023). Global assessments usually simplify measurement indicators for between-country comparisons, whereas nationally generated data are used for within-country comparisons or national policies (Raimondo *et al.* 2023), which is where protection and restoration happens (Nicholson et al 2024). For instance, the disaggregated global Red List Index, derived from the IUCN Red List of Threatened Species, enables country-level comparisons but based only a limited set of taxonomic groups with complete global coverage. In contrast, data for more taxonomic groups in national red list indexes are available in some countries, allowing a more complete picture of the status of biodiversity (Raimondo *et al*., 2023). Mair *et al.* (2023) used national red lists from South Africa in STARt and STARr analyses and demonstrated 30 times higher scores for vascular plants than for vertebrates, which are not reflected in the current global application of STAR used in these analyses. Given that frameworks like TNFD require location-specific scales, our results strongly suggest that national datasets should be used, where available, even during initial screening by companies.

Several factors influence discrepancies of global and national datasets. First, extensive verification processes, involving direct field assessments and expert knowledge, has enhanced the accuracy of national ecosystem assessments, including in the case study area, South Africa (Pool-Stanvliet *et al.* 2017; Dayaram *et al.* 2019; Skowno & Monyeki 2021). These efforts have been boosted through national legislation; for example, the South African National Biodiversity Institute (SANBI) has a legal mandate under the Biodiversity Act to identify threatened ecosystems and has updated this since its first list of threatened ecosystems published in 2011. Field verifications have not been conducted for the model-based indices EII, MSA, and HMI. Second, national datasets often contain high-resolution satellite imagery (10 m to 30 m grid sizes in the present study), whereas global datasets have coarser resolutions (1 km to 5 km grid sizes). Third, updates of global datasets, such as mapped WDPA or KBAs, depend on the frequency of information provided by many national authorities. This could lead to outdated records that do not reflect current conditions and increase uncertainty of data accuracy (Murray *et al.* 2021), even if some nations provide accurate data. Data cleaning procedures may also exclude relevant but incomplete data (Protected Planet 2021). Finally, differences in the scope of each dataset, even within the same criterion, influence screening results. STAR restoration (STARr), for example, reflects the restoration potential of the degraded habitat for some taxonomic groups (Mair *et al.* 2021), which measures fundamentally different aspects of biodiversity compared to the protected areas or priority areas such as CBAs.

Our findings showed that using multiple global datasets increases the proportion of agreed inclusion and reduces omission errors. However, we still observed substantial proportions of omission errors, particularly in biodiversity importance, 19.7% in Fynbos and 21.3% in Albany Thicket, even with multiple global datasets application. Therefore, where these global datasets are used, we recommend setting buffers for area-based datasets, and conservative thresholds for continuous metric types to deal with the risks of omission errors. For area-based datasets, IBAT, for example, has a reporting format which provide screening results within a standard 50km buffer (IBAT 2020). This means that any site within a 50km radius of WDPA, KBAs, and IUCN Red List of Threatened Species (CR & EN) will be flagged, indicating its proximity to these critical biodiversity sites. For continuous metric types such as EII, MSA and HMI, it is important to acknowledge that these model-based datasets inherently contain model uncertainty that is difficult to quantify and impossible to eliminate (Regan *et al.* 2002). As we observed in our sensitivity analysis (Fig. 3), setting conservative thresholds should be encouraged to minimise omission errors.

Using multiple criteria for ecologically sensitive locations can provide additional information that can support further prioritisation of each site for conservation activities or understanding of more sensitive areas to business activities. Combined use of three criteria applied in the national datasets (Fig. 2), for example, identify areas which are high biodiversity values but low integrity status with rapidly declining (high vulnerability) – these areas may need urgent actions (Pressey & Taffs 2001). More specifically, a site that contains a critically endangered ecosystem or species with moderate or low integrity may be very valuable for the viability of the ecosystem and the species it supports, given that some threatened ecosystems may remain only in small, degraded patches (Wintle *et al.* 2019). On the other hand, the use of multiple criteria should not preclude the value of each criterion. For example, large areas of intact forest ecosystems have key roles in sustaining biodiversity and ecosystem services (Watson *et al.* 2018). Given the complexity of biodiversity, which includes many different aspects, there is no single approach to measure it; each method offers distinct insights into the biodiversity of an area (Harrer *et al.* 2024; Mendez Angarita *et al.* 2025). Screening and prioritisation should consider the roles of each criterion and their specific purpose, and the additional information they can bring by being used together.

While data developed or validated by the national authority in South Africa generally provide finer-scales dataset, these national datasets are still in the process of further improvement. Due to the interaction between the complex temporal and spatial dynamics of nature and human capacity to survey, there are different types of shortfalls in most biodiversity data (Hortal *et al.* 2015). For example, distinguishing between areas in good ecological condition (natural or near-natural) and those in fair condition (semi-natural), using land cover data alone is often challenging, which can lead to overestimating areas in good condition (SANBI 2017). Invasive plant species, for example, are a major pressure on biodiversity in South Africa, including the Albany Thicket and Fynbos biomes (O'Connor & van Wilgen 2020). Despite the significance of the concerns, degradation due to invasion by alien plant species or factors such as overgrazing is not currently adequately included in the national condition mapping, though work is ongoing to address this, including further research on the ground. These limitations are common or even pronounced in other countries, and the scarcity of time-series data influences the reliability of detecting and estimating rates of change (Rowland *et al.* 2018).

While national and local biodiversity are likely to be important for private sector assessments, investment is needed to make this feasible. Biodiversity spatial data availability and transparency need substantial improvements for wider use (zu Ermgassen *et al.* 2022). Few of them are accessible or practical for business purposes (Harrer *et al*. 2024). Most publicly available spatial data repositories and platforms focus on global data (e.g. https://unbiodiversitylab.org/), but some support efforts to also compile national data (for example, the Global Ecosystems Atlas, https://globalecosystemsatlas.org/). In South Africa, the Red List of Ecosystems assessment data is publicly available on the SANBI website (https://bgis.sanbi.org/Projects/Detail/1233/ or https://ecosystemstatus.sanbi.org.za), but the other datasets we used were obtained through requests to SANBI. Some other countries have their Red List of Ecosystems data publicly available (e.g. Colombia (Etter *et al.* 2020), Chile (Pliscoff 2015), Italy (Capotorti *et al.* 2023)), but are in the minority. Also, some companies are developing and using proprietary rating tools and metrics for measuring biodiversity impacts and dependencies with undisclosed underlying methodologies (Irvine-Broque & Dempsey 2023). However, it is important to ensure a non-arbitrary dataset selection process for the transparency and credibility of assessments. Ideally, datasets recommended or approved by national authorities should be encouraged for use in these assessments.

Challenges remain, as not all countries have accurate and comprehensive databases comparable to South Africa's. Recent analyses suggest that only approximately one third of the 196 Parties of the CBD have comprehensive ecosystem assessments (Nicholson *et al.* 2024). Further efforts are required to build bottom-up global significance metrics based on fine-scale field research, enabling experts to observe, estimate or infer parameters (Hawkins *et al.* 2024). Another practical challenge for companies is the limited availability of human resources with ecological knowledge and spatial analysis skills. Addressing this issue requires ongoing efforts to enhance the capacities of both internal teams and external partners (Bebbington *et al.* 2024). In the short term, therefore, there may be a transitional phase where global data usage is necessary, but companies should move towards nationally available data uses when fine-scale, field validated, and more frequently updated data are available even in the initial screening stages. With limited time to address the nature crisis, we need to use the most reliable and accurate data currently available.

Our study demonstrates the reliability of screening results in identifying ecologically sensitive areas is dependent on the selection of datasets and criteria. Inaccurate and incomplete datasets can mislead companies, constrain decision-making and, ultimately, limit opportunities to address the biodiversity crisis. The comparative analysis between global and national datasets revealed the discrepancies, particularly in the identification of biodiversity important areas, where global datasets frequently missed critical sites identified by more precise national data. This misalignment highlights the need for incorporating national datasets even in the initial screening stages and using the best possible data throughout decision-making, especially in countries such as South Africa. Further investment should be directed towards the development and improvement of national, bottom-up databases to improve the accuracy and reliability of data. This will enable countries to enhance global reporting, such as the Global Biodiversity Framework, improve national policy development, and support private sector initiatives.

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Figures

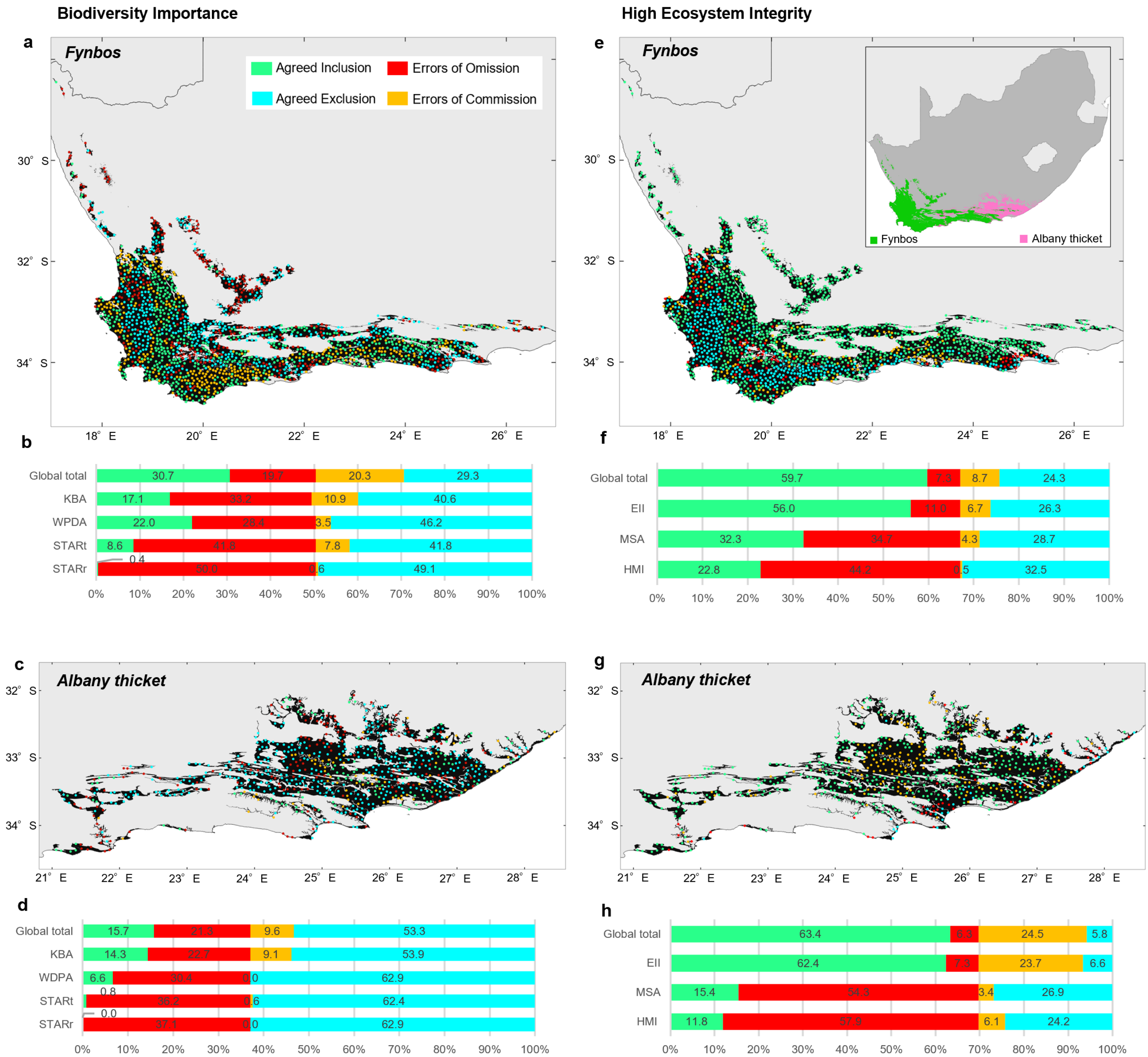

Fig. 1: Screening results comparing global and national datasets. a, Screening results for biodiversity importance mapped in Fynbos, **b,** Screening results for biodiversity importance by each global dataset in Fynbos, **c,** Screening results for biodiversity importance mapped in Albany Thicket. **d,** Screening results for biodiversity importance by each global dataset in Albany Thicket. **e,** Screening results for high ecosystem integrity mapped in Fynbos, **f,** Screening results for high ecosystem integrity by each global dataset in Fynbos, **g,** Screening results for high ecosystem integrity mapped in Albany Thicket, and, **h,** Screening results for high ecosystem integrity by each global dataset in Albany Thicket.

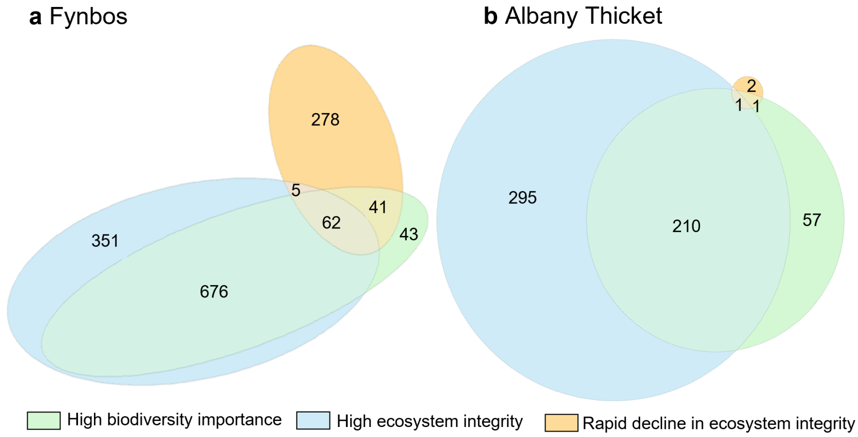

Fig. 2: Venn diagram on screening results by three criteria, biodiversity importance, high ecosystem integrity, and rapid decline of ecosystem integrity using national datasets. a, results in Fynbos, and **b,** results in Albany Thicket.

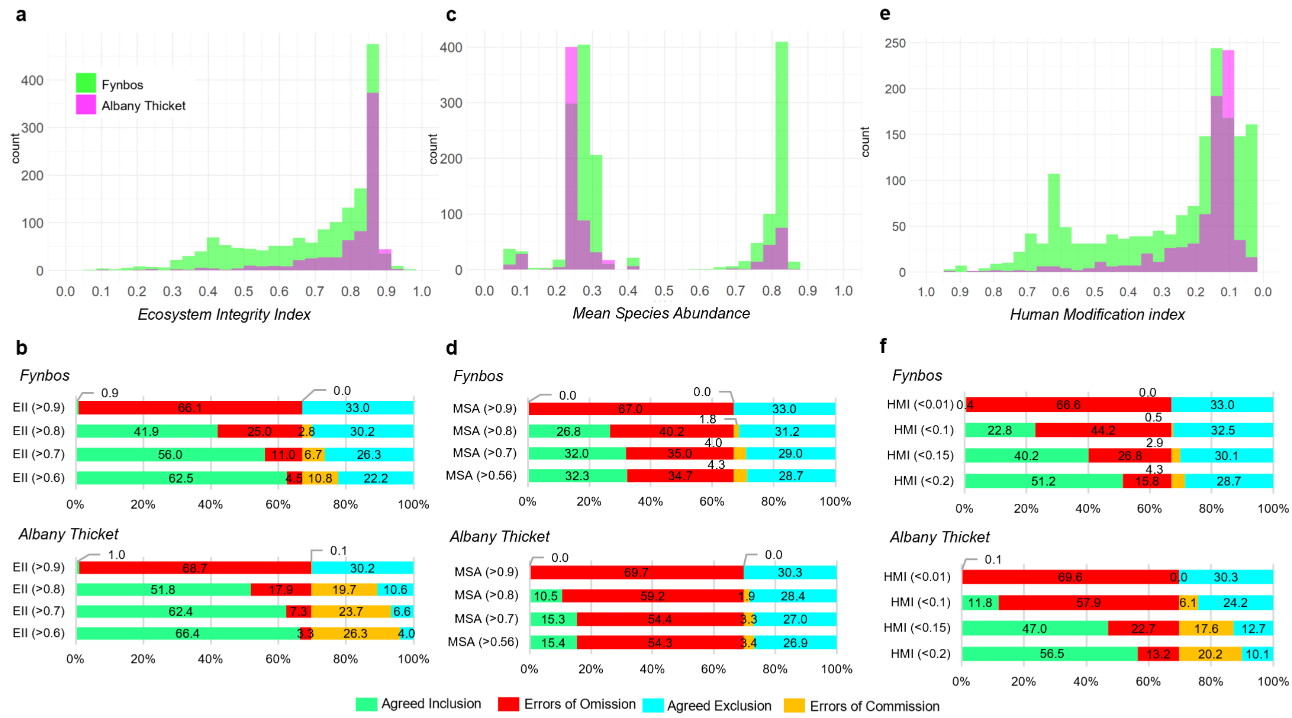

Fig. 3: Sensitivity analysis of screening outcomes to threshold settings for high ecosystem integrity. a, Histograms of the frequency distributions for Ecosystem Integrity Index (EII) in Fynbos, and in Albany Thicket, **b,** Sensitivity analysis for EII, **c,** Mean Species Abundance (MSA) in Fynbos and in Albany Thicket, **d,** Sensitivity analysis for MSA, **e,** Human Modification Index (HMI) in Fynbos and in Albany Thicket , **f,** Sensitivity analysis for HMI.

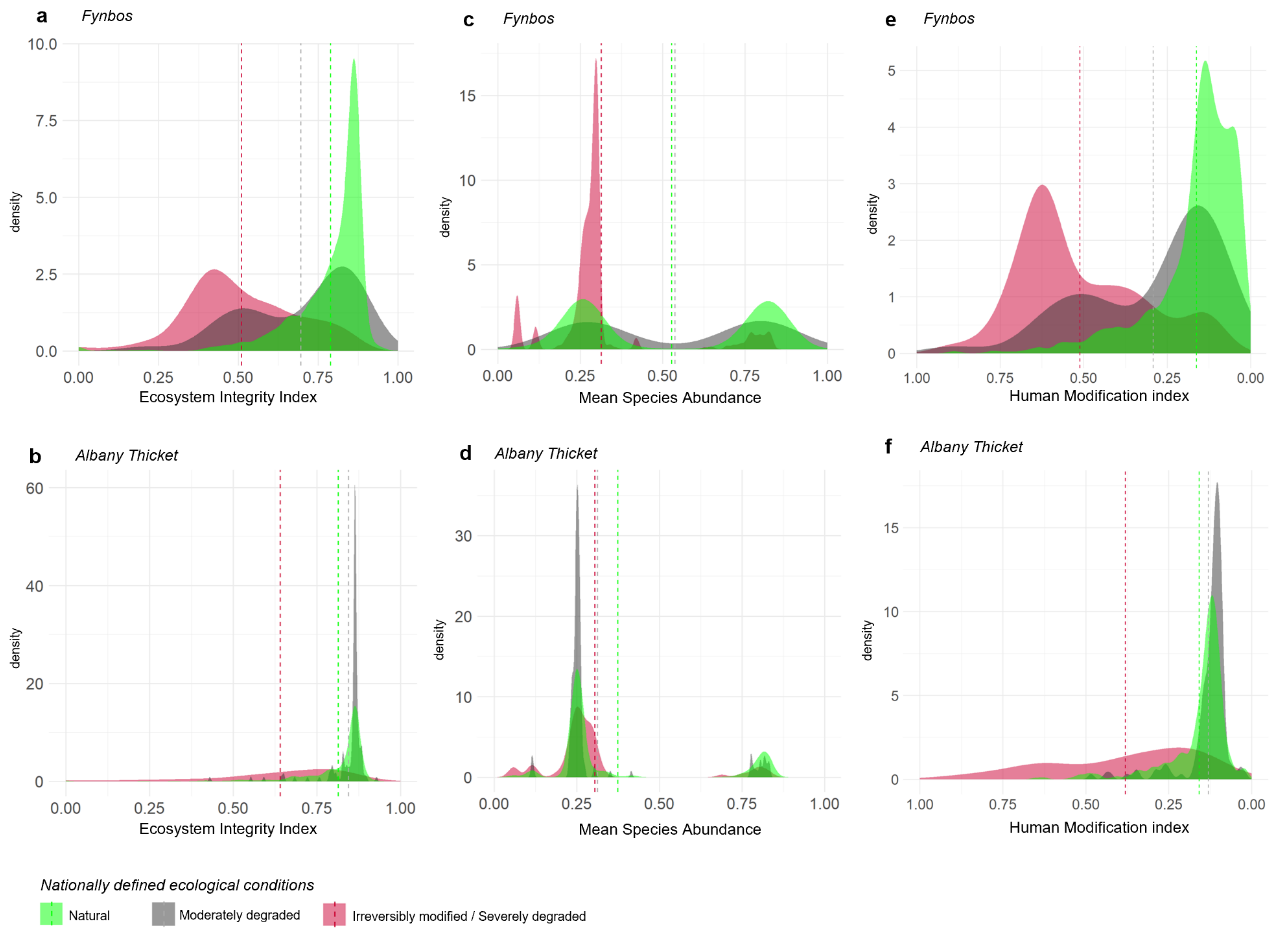

Fig. 4: Comparison between nationally defined ecological condition classes with global Integrity datasets. a, EII density plot in Fynbos with nationally defined ecological condition, **b,** EII density plot in Albany Thicket with nationally defined ecological conditions. **c,** MSA density plot in Fynbos with nationally defined ecological conditions. **d,** MSA density plot in Albany Thicket with nationally defined ecological conditions. **e,** HMI density plot in Fynbos with nationally defined ecological condition, **f,** HMI density plot in Albany Thicket with nationally defined ecological conditions.