Metrics in Biodiversity Conservation and the Value-Free Ideal

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Abstract

This paper examines one aspect of the legacy of the Value-Free Ideal in conservation science: the view that measurements and metrics in conservation are value-free epistemic tools detached from ideological, ethical, social, and, generally, non-epistemic considerations. Contrary to this view, I will argue that traditional measurement practices entrenched in conservation are in fact permeated with non-epistemic values. I challenge the received view by revealing three non-epistemic assumptions underlying traditional metrics: 1) a human-environment demarcation, 2) the desirability of a people-free landscape, and 3) the exclusion of cultural diversity from biodiversity. I also draw a connection between arguments for retaining traditional metrics to "scientific colonialism," exemplified by a fortress conservation model. I conclude by advocating for abandoning the myth of the intrinsic value-freedom of measurement practices and embracing metrics aligned with societal and scientific goals.

Keywords: value-free ideal, biodiversity conservation, critical metrology, scientific colonialism.

1 Introduction

Conservation heavily relies on quantitative data and measurements. Performance metrics are tools that assess the success of conservation strategies

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implemented to prevent biodiversity loss, such as the decrease of genetic variability, taxonomic decline, or ecosystem loss of functionality. Performance metrics are used to provide an allegedly value-free, standardized, and transparent quantification of how well policy measures have met their goal (Muller, 2018). In conservation, strategies whose performances can be assessed include, for instance, establishing protected areas (PAs) and mitigating species' extinction risk.

This paper challenges the view that measurements and metrics in conservation are value-free epistemic tools detached from ideological, ethical, social, and, generally, non-epistemic considerations. Traditional measurement practices entrenched in conservation are in fact permeated with non-epistemic values. Furthermore, orthodox conservation metrics do not do justice to recent ecological findings; therefore, they are also epistemically flawed. However, the epistemic privilege often granted to "neutral" measurement practices justifies specific forms of social oppression perpetuated under the banner of conservation science. This type of oppression is known as "scientific" colonialism and is especially felt by indigenous communities inhabiting biodiversity hotspots.

I diagnose that the resistance to developing metrics that could avoid some of these social harms and could be more epistemically robust is due to an enduring myth that more or less unknowingly haunts biodiversity conservation: the value-free ideal (VFI) of science. According to this position, more robust scientific knowledge is obtained after detaching research from sociopolitical values and subjective expert judgment. Even though the VFI does not have many outspoken supporters, its legacy pervades the scientific discourse around using or excluding selected metrics as reliable tools to assess how well conservation action is faring. This legacy hampers the development and implementation of metrics that are better aligned with inclusive values and goals and attuned to updated scientific research[1] I echo a small group of conservationists advocating for the development of metrics that are more sensitive and aware of how non-epistemic values play out in measurement practices.

I present my argument in several steps. First, I defend the claim that the VFI has a notable legacy, namely the idea that certain measurement practices provide a value-free description of reality and, as such, are epistemically privileged tools for evidence-based policy (Section 2). Next, I

[1] This chapter explicitly criticizes this legacy of the VFI in relation to measurements, not the VFI itself.

explore how the supposed value-freedom of metrics applies to conservation science. After introducing common metrics used to gauge conservation efforts (Section 3), I show how conservation assessments traditionally separate value-free metrics—e.g., environmental parameters—from value-laden metrics—e.g., indices measuring human systems like well-being and cultural diversity—(Sections 4). Then I challenge the prevailing view that traditional conservation metrics are value-free by identifying three assumptions underlying their development and selection: 1) a sharp distinction between humans and the environment, 2) the belief that a human-free landscape is the most desirable state, and 3) the exclusion of cultural diversity as a facet of biodiversity (Section 5). These assumptions stem from normative commitments or obsolete ideologies and contradict recent empirical findings, making their retention a non-epistemic matter. I then explore how the defense of allegedly value-free metrics by conservationists constitutes a form of "scientific colonialism" because it justifies policies that oppress local and indigenous communities through warranting a "fortress conservation" model (Section 6). I also employ a case study to exemplify the continued influence of the VFI in metric selection and the expectation of colonial harm (Section 6.1). I conclude by suggesting that the development and choice of performance metrics cannot be free of values, therefore should align with societal and scientific goals and interests (Section 7).

2 The Value-Free Ideal of Science

In recent years, philosophers have thoroughly explored the contextual elements that influence the production of scientific knowledge, such as funding schemes (Shaw, 2022), social power structures (Wylie, 1992; Longino, 2013), and ethical and political value judgments (Anderson, 2004; Elliott, 2011). Special emphasis has been placed on how non-epistemic values and goals—such as "safety, sustainability, equality, nonmaleficence, reliability, economic prosperity and wellbeing"(Diekmann & Peterson, 2013, p.211)—drive the attainment of scientific knowledge claims in various fields, including engineering (Diekmann & Peterson, 2013), climate science (Winsberg, 2012), and environmental science (Elliott & McKaughan, 2014).

Philosophers have documented the uneasiness surrounding the compatibility of scientific knowledge with both epistemic reliability and the consideration of socio-political and ethical factors.[2] Including non-epistemic considerations in scientific outcomes could potentially bring negative epistemic consequences. Some argue that socio-political purposes may pose a threat to the extent to which scientific claims accurately represent natural phenomena——which still constitutes, reasonably or not, one of science's most highly esteemed goals. Thus, potential tradeoffs may need to be negotiated between the accuracy of a scientific model or hypothesis and its desirability from a socio-political perspective. Implementing non-epistemic values, in addition, might lead to public distrust of science, which is especially salient when scientific expertise blends with policymaking (Cologna, Baumberger, Knutti, Oreskes, & Berthold, 2022).[3]

Philosophers have explained the resistance to legitimizing non-epistemic considerations in the determination of scientific knowledge claims in terms of the "value-free ideal" (VFI) of science (Douglas, 2009). According to the VFI, the epistemic goals of science, such as a faithful representation of the world or predictive accuracy, depend on how scientists can keep their science "immaculate" from preferences, biases, and socio-political considerations. A corollary to this view is that scientists must set aside non-epistemic goals when pursuing scientific knowledge. This is not to say that non-epistemic considerations should be disregarded when determining the scientific inquiries worth pursuing or how to implement scientific knowledge. This latter responsibility, however, largely falls within the purview of policymakers, not scientists.

Although no universal characterization of the VFI can be extrapolated from the philosophical literature, some versions of this view are endorsed by prominent philosophers (for example, Lacey, 1999, Sober, 2007 Betz, 2013). In scientific circles, "the sacred narrative of value-neutral virginity" (Mandel & Tetlock, 2016) of science seems to have been abandoned (see examples in psychology Griffiths et al., 1995, and economics Małecka, 2021). Similarly, philosophers of science have long criticized this view's historical veracity, practicality, and desirability (see, for example, Harding, 1991 and Longino, 2013, or Kitcher, 2001). Despite its general rejection, some have recently defended the VFI as a useful—though unattainable—pragmatic stance whose role would be to balance science's epistemic and non-epistemic objectives and

[2]Prominent here are the works of Heather Douglas (2009) and Kevin Elliott (2017).

[3]Curiously enough, empirical work has drawn a much more complex picture of the public perception of values in science (Cologna et al., 2022)

monitor research integrity (see, for example, Ambrosj, Dierickx, & Desmond, 2023, Menon & Stegenga, 2023).

Nonetheless, some *legacies* of the VFI are still alive and kicking. This is especially true in evidence-based approaches to science, which explicitly set as desiderata the attainment of, among others, value-freedom, standardization, and transparency. Evidence-based conservation, for instance, revolves around grounding biodiversity protection on facts and data, repudiating ecologists' personal values and subjective expert judgment that have traditionally, and often mistakenly, guided conservation action. (Kareiva & Marvier, 2017; Sutherland, Pullin, Dolman, & Knight, 2004). Spotting remnants of the VFI, however, is not easy. The VFI can manifest itself through a legacy of what can be called "unknown knowns" (S. T. Jackson, 2012), meaning implicit assumptions embedded in research practices that science practitioners are not openly invited to question or that pervade the public image of science.

2.1 The Legacy of the VFI & Metrics

This paper focuses on a specific aspect of the legacy of the VFI in connection with measurements, namely the presumption that measurement practices—including collecting quantitative data and developing metrics—provide a value-free description of the world, a description which is then liable to subjective interpretation and implementation. Said differently: one component of the legacies of the VFI is the claim that certain types of empirical data, such as measurements and their condensation in metrics, are value-free and can provide a purely factual description of natural or social phenomena. By virtue of their alleged value-free character, measurements and metrics have been legitimized as epistemically privileged.[4] The legitimization of the epistemic prominence of measurement practices translates into a normative implication: It is generally agreed that measurements and metrics should be prioritized in producing scientific knowledge and evaluating science-based policies.

The presumption of value-freedom of measurements inherited from the VFI extends to several scientific disciplines. Historian Jerry Z. Muller (2018) calls "metrics fixation" the attitude of celebrating scientific knowledge resulting from sophisticated measurements and insisting on the epistemic salience

[4]Whether measurements are genuinely epistemically privileged or are only legitimized as such is an ongoing debate in philosophy of metrology. See Ohnesorge, 2022 for an introduction to various positions on how measurements are genuinely epistemically privileged.

of metrics as tools to achieve value-free, evidence-based, less personal science. Muller critically documents how metrics have held the standard of good evidence and value-freedom in social sciences such as medicine, economics, public policy, and pedagogy. However, metric fixation is also common in natural sciences, especially biodiversity research, where "measures are intended to ensure the generation of transparent, reliable, and standardized information that can be used to objectively assess the effectiveness and efficiency of conservation" (Turnhout, Neves, & De Lijster, 2014). As we shall see, this narrative around the value-freedom of measurement is misplaced and can be socially dangerous.

This paper concerns the development and selection of metrics, as a type of measurement practice. Metrics are quantitative standards represented by mathematical formulas (Merriam-Webster). They are used to assign numerical values to qualitative phenomena or processes by amalgamating various measurements obtained from the system under investigation. Some metrics are meant to estimate *success*: these are called "performance metrics" (Muller, 2018). *Productivity* and a *journal impact factor*, for instance, are performance metrics. Metrics pervade evidence-based approaches to policy such as public health and clinical practice (Guyatt et al., 1992), sustainability (Caniglia et al., 2017), and the education sector (Biesta, 2010), where interventions have faced criticism for excessive reliance on inadequate evidence or flawed data. Metrics offer a way to harness data effectively and gauge the efficiency of resource allocation. Additionally, metrics promote standardization and transparency, while emphasizing accountability in the eyes of the public and investors (Muller, 2018).

But one of the most praised attributes of metrics connects with the legacy of the VFI: their ability to replace the subjective opinions of experts when assessing policy (see, for example, Nguyen, 2022). Substituting expert judgment with standard metrics aligns with the principles of evidence-based policy, emphasizing rigor and value neutrality. Historian of science Theodore Porter has documented how the "negation of subjectivity" (Porter, 2003, p.242) has been the hallmark of modern science and has been partly accomplished by elevating measurements to the role of the ultimate guarantee of scientific knowledge and decision making, separating science from the perceived subjectivity of experimenters and natural scientists. Porter has also related the detachment from personal judgment to democratic systems where public trust in science must be gained if not to obtain funding and approval (Porter, 1996). Similarly, Muller has argued that performance metrics are welcomed as epistemically privileged tools since they are "supposed to provide information that is hard and objective" (Muller, 2018, p.6), unbiased, impartial, and factual.

Recently, philosophers and scientists have explored the intersection of measurements and values in science, revealing how non-epistemic considerations are entrenched in measurement practices, so that social discrimination and harm can result from the often-unstated value-laden nature of metrics and measures. For instance, the emerging field of "critical metrology" investigates hidden values and biases in measurement practices by paying special attention to "the intersection of measurement and oppression" (Boulicault, Manuscript).[5] Unstated assumptions inevitably embedded within measurement practices have surfaced within the philosophical and scientific literature and solutions to nurture more reliable and equitable measurement practices have been advanced. This scholarly trend offers a counternarrative that disputes the legacy of the VFI according to which measurements can and should be devoid of values. In the next sections, I connect this aspect of the legacy of the VFI to conservation practices, dispute it, and then show the possible societal drawbacks of clinging to this view.

3 Metrics in Biodiversity Conservation

Performance metrics in conservation are designed to assess the success of protection or restoration efforts in relation to conservation objectives, with the ultimate goal of piloting effective resource allocation (Sutherland et al., 2004). Most conservation projects aspire to protect biodiversity by removing threats to certain species or fragile habitats. Designating protected areas (PAs) where human presence is limited —- in terms of resource extraction, hunting, harvesting, etc.—is one of the most effective ways to restore declining ecosystems (Possingham, Wilson, Andelman, & Vynne, 2006). Protected areas, such as national parks, natural preserves, and marine sanctuaries, have gained notoriety as conservation models that disrupt unregulated access to

[5] To the best of my knowledge, "critical metrology," as I use it, is due to Marion Boulicault. Philosophers advancing this critical metrology research program have highlighted how theoretical assumptions, biases, and other non-epistemic considerations influence metric development, choice, and endurance (see Boulicault, Manuscript for an example from fertility studies), as well as the development of measurement instruments (R. L. Jackson & Wassermann, 2022 for an example in phallometry and cervimetry).

and exploitation of biodiversity.[6]

In conservation, the success of conservation projects is assessed in one of two ways: either by measuring the *implementation* or the *outcome* of a strategy (Kapos et al., 2009). The first approach consists of quantifying the extent to which a project has been implemented with respect to a pre-decided scheme. Consider, for example, establishing protected areas as a strategy to preserve biodiversity. In this case, a criterion for conservation success might be the expansion of land under legal or ecological safeguards to meet a certain target.

A performance metric quantifying conservation success following this approach is known as *total protected area coverage*, which is basically a measurement of the percentage of protected land over the total land area, legally and/or ecologically. Although a percentage exemplifies total protected area coverage, how the percentage is calculated can be accomplished by a set of indices. Protected area coverage metrics proxy the level of protection afforded to habitats and species within a given region. For example, the Convention on Biological Diversity (CBD) established the AICHI targets to protect 17% of land and 10% of the ocean globally by 2020. Despite failing to meet this global goal, certain countries have been extremely successful in implementing regulations locally: more than 50% of Venezuela's land is under some form of protection, followed by more than 40% of Greenland's territory (Our World in Data).

Some well-known limitations exist in using protected area coverage as a metric to capture conservation performance optimally. One of the most notable obstacles is representative distribution(Barr et al., 2011). Since regulated areas are usually confined to economically undesirable locations and do not necessarily extend equally to a valued area, relying on indicators signaling the overall percentage of the protected area might mislead us into thinking that a sufficiently representative effort has been put in place. Simple metrics adopted by the CBD, for example, "can (and often do) obscure the continuing decline of biodiversity while showing positive trends" (Watson et al., 2016, p. 245).

Some solutions to the black box issue of using total protected area coverage have been advanced by accompanying this index with other indices

[6] Implementing these kinds of strategies is known as the *direct* approach to conservation (Stoll-Kleemann et al., 2006) as opposed educating or involving the public in conservation projects (*indirect* approach). Direct maneuvers are preferred because their impact is more easily measurable than that of indirect strategies (Gruber, Mbatu, Johns, & Dixon, 2018).

targeting the missing information. Borrowing from economics, in which performance metrics have reached high sophistication, biologist Lissa Barr and colleagues suggest "that the economic metric of inequality, the Gini coefficient, be adapted to report protected area coverage." (Barr et al., 2011, p. e24707). Combined with other metrics for protected area coverage, this newly introduced metric can provide more insights into the quality of the area under protection.

The second approach to measure the success of conservation is to determine whether the project's expected key outcomes have been met (Kapos et al., 2009). Key outcomes are usually the attainment of biological or abiotic "thresholds," meaning environmental ranges of variability within which populations or ecosystems are relatively stable, compositionally or functionally (Gillson, 2015). For example, a decrease in a species' abundance under a certain limit might lead to a high risk of extinction.

Biological thresholds that signal how well conservation is implemented could include preventing species' decline under a suspicious limit, preserving species richness, habitat connectivity, or extinction risk. These are commonly used metrics that crosscut a wide range of conservation efforts, from the establishment of protected areas to urban restoration projects.

Calculating species' extinction risk, specifically with metrics involving abundance and area of occupancy measurements, is one of the most widely adopted metrics of conservation success, embraced by high-profile organizations such as the IUCN. In addition, indices of species richness and abundance—such as the Shannon Index or Gini-Simpson—have predominantly been used to assess biodiversity management and affect public reception (Hébert & Gravel, n.d.).

Some limitations are acknowledged and tolerated in using metrics that assess the success of a conservation action by measuring biological thresholds for which indices are available. It is widely discussed that biodiversity is rarely reified in terms of species richness and abundance indices (Bocchi, 2022, Santana, 2018, Magurran, 2004). Consequently, focusing on population abundance, richness or extinction risk as the best performance metrics for conservation success has been highly criticized (see, for example, Fleishman, Noss, & Noon, 2006, Brown et al., 2015). This criticism gets especially thorny if we consider that some high-profile conservation actions revolve around an "umbrella" species, whose status is used as a proxy to represent the status of many related taxa. Since the correlation between capitalized species and the other taxa has been demonstrated to be weaker than predicted, the inference

Hypothetical Assessment Table for Conservation Success				
Metric Type	Index	Target	Current Status	Priority (Or Relative Weight)
Species richness and/or abundance	Individual Count	5000 individuals	4500 units	Top priority
Habitat quality	Habitat quality index (HQI) (Li et al. 2021)al. 2021)	HQI=0.32 or higher	HQI= 0.2-0.23 (low HQI values)	Low priority
Ecosystem function	Normalized Difference Vegetation Index (NDVI) (Cabello et al. 2012)	NDVI= 0.91> < 1	NDVI= 0.1 (values closer to zero signal absence of canopy)	Analysis not performed
Percentage of Land Under Legal	Total protected area coverage	17% of a species habitat (towards	0 %	Low priority

Figure 1:
Illustrative example of a list comprising metrics to assess conservation success. The operationalization of these metrics into indices is based on a review of recent literature, whereas the values are hypothetical, as well as the prioritization status. Overall, a project is successful if it reaches its target in the highest priority category, even if it has failed in the lowest priority thresholds. Biological and abiotic parameters are considered, but no measure related to human systems (socio-cultural diversity, well-being) is usually included.

is spurious (Roberge & Angelstam, 2004).

Due to the limitations of individual metrics, conservation success is usually estimated with a set of metrics, displayed in a table or matrix in a structured format (such as in Gruber et al., 2018). Graphically, this assessment process can be represented by a table with two axes. On one axis, various metrics that assess the implementation or outcome of a strategy are displayed: these usually include environment-oriented measures, both as biological parameters (such as species abundance trends) and abiotic parameters (such as the percentage of protected land), but also cost-effectiveness measures. The values and/or benchmarks of those parameters are displayed on the other axis. Consider Table 1, which represents a hypothetical assessment scenario with arbitrary values. To assess whether a conservation action has been successful or unsuccessful, the table displays various metrics relevant to conservation, their quantitative status, and their relative weight.

Tables such as 1 can provide a clear and concise overview of the status of an ecosystem or habitat before, during, and after conservation action is taken. The general purpose of using them is to perform an overall assessment instead of reifying the conservation success in a unique metric. Through these schematic representations, conservation scientists, policymakers, and the public can consult trends of biological and abiotic parameters within a system—such as an increase or decrease of species abundance or ecosystem functionality with respect to a certain target, as well as the improvement in legal protection extended to an area subject to conservation efforts.[7]

4 Excluding Human-Related Metrics from Conservation Success

As we have seen, most conservation projects conceptualize successful conservation action primarily as attaining a certain percentage of protected land,—for example, the expansion of up to 30% of protected land and ocean globally— or attaining biological or abiotic thresholds—such as the reintroduction of a certain number of specimens in an ecosystem. Now, studies mapping human impact on the land surface have shown that only between 20 and 40% is under low human influence (Plumptre et al., 2021), and only 2.8% of terrestrial fauna is "intact" from anthropogenic leverage (Riggio et al., 2020). This means that protection and restoration measures are implemented within areas subject to human settlement and exploitation (Ellis & Ramankutty, 2008). All human societies, especially local and indigenous groups, respond directly to the availability of natural resources. It might, therefore, come as a surprise that human-related parameters, such as the extent to which a community can benefit or suffer from a protected area or a restoration project, are absent from the table above. This should be even more surprising considering that metrics to assess human responses to policy are available: for instance, health or well-being indices or measurements of sociocultural diversity. Wellbeing indices are formulas used to

[7] Conservation organizations—such as the IUCN, the World Wildlife Forum (WWF), and Unesco—apply one or more of the above-mentioned metrics in assessing their measures to mitigate the ongoing environmental crisis. For example, since 2012 the IUCN has developed measurements to signal the updated recovery status of species due to conservation efforts. This new system of measurement is known as the IUCN Green Status of Species. Quantifying species recovery is deemed to be "on objective, transparent, and repeatable criteria for systematically assessing successful species conservation (WCC-2012-Res-041)" (Grace et al., 2021, p. 1839).

assess the overall quality of life of individuals or populations. They typically include multiple factors such as health, education, income, and social and environmental conditions to provide a comprehensive evaluation of well-being. Metrics for estimating social or cultural diversity are also available. Cultural diversity refers to a spectrum of cultural and ethnic traits such as belief systems, traditions, and practices—language, food, music, art, religion, and social protocols. Measuring cultural diversity is a complex task and usually happens via proxies. An approach is to collect demographic data. This involves analyzing the distribution of different ethnic and cultural groups within a society or region. Parameters that can be easily quantified are, for example, the number of spoken languages, the percentage of alien residents, or the variety of religious practices. These data can be used to quantify the level of cultural diversity and track changes over time. Another approach is through indices meant to capture various dimensions of cultural diversity, factoring in, for instance, the number of artistic events or cultural institutions and the variety of media content. Well-being and socio-cultural diversity metrics could be included in measurement matrices to assess the impact of conservation practices on human systems.

Many conservationists increasingly support including human-related metrics alongside those from non-human ecology in assessing restoration and protection maneuvers. A primary critique of exclusively adopting traditional metrics is that their usage alone bypasses numerous factors leading to the overall success of conservation (Heller, McManus Chauvin, Skybrook, & Barnosky, 2023, Pascual et al., 2021, Bennett et al., 2017Mascia et al., 2003). In addition to environmental factors, social and cultural elements such as conflict, access to resources, educational opportunities, and customs may be decisive in the success of a conservation effort (Gruber et al., 2018). These human-relevant factors should be taken into account when predicting the success of conservation initiatives, alongside environmental parameters. In order to demonstrate how the use of more comprehensive metrics can affect the prediction of conservation performance, a study by Gruber et al. (2018) compared the results obtained using traditional metrics based solely on environmental considerations with those obtained using a "holistic matrix" that incorporates social, cultural, and political factors. The results obtained using the two measurement frameworks indicated that certain conservation efforts, including projects in Costa Rica, the Mekong Valley, and the Congo Basin, which were deemed successful according to traditional metrics used by organizations such as UNESCO and WWF, were not as successful according to the more inclusive matrix. The authors suggest that conservation NGOs should take this into account when setting future expectations and allocating resources.

However, there is still resistance to including human-related metrics in the assessment of conservation success beyond the quantification of biological parameters and the coverage of protected areas. Biodiversity conservation traditionally gravitates around "quantity and quality of biodiversity (increasing the number and distinctness of species) rather than whole faunas and floras ecosystems and communities" (Gruber et al., 2018, p.28). In addition, this resistance stems from the historical dominance of natural sciences over social sciences surrounding the conservation discourse (Bennett et al., 2017, p.94), which backs the belief that human systems are not within the proper scope of conservation efforts insofar as science is concerned.

In addition to this, when human-related considerations are concerned, there is a shared sense that non-epistemic matters, such as issues of values become hardly distinguishable from epistemic ones. Including non-epistemic concerns in the "objective" assessment of conservation could potentially overshadow its true purpose, which is to understand ecological patterns and protect them. In the conservation science community, public policy and politics are responsible for addressing matters of values, such as well-being and sociocultural diversity. Consequently, human-related metrics are deemed more appropriate for the consideration of policymakers rather than falling under the purview of biodiversity science. Thus, while metrics involving human factors may have a place, the primary measurement of conservation effectiveness should focus on traditional parameters aligning directly with conservation goals.

William Sutherland, a pioneer of evidence-based conservation, introduced a distinction between the "efficacy" and "effectiveness" of conservation actions to corroborate the claim that sociocultural considerations lie outside conservation science, strictly speaking. Efficacy refers to the biological response of a system to a management plan, whereas effectiveness considers the success of a conservation strategy within a specific sociopolitical context (Sutherland, Pullin, Dolman, & Knight, 2005). By drawing an analogy from medicine, Sutherland highlights that a highly efficacious vaccine might not be effective due to social, economic, or political circumstances hindering its implementation. Similarly, in conservation, there should be a distinction between efficacy and implementation within a given context. Measuring the effectiveness of a conservation effort depends on the outcomes measured in initial research while measuring efficacy is independent of the sociopolitical context. This underscores the need to differentiate between environmental parameters relevant to biodiversity scientists and socio-cultural measurements relevant to policymakers.

The exclusion of sociocultural, ethical, and political considerations, along with the corresponding metrics, from the realm of biodiversity science and their relegation to policymaking reflects the influence of the VFI. Rejecting non-epistemic considerations in performance metrics aligns with the view that measurement practices should strive for value freedom. Including metrics related to human well-being and sociocultural diversity in conservation assessments implicitly signifies a commitment to values and value judgments, which are non-epistemic motivations. Therefore, proponents of the VFI argue that conservation actions based on scientifically sound measures are more epistemically robust. This does not imply disregarding measures of human well-being in conservation efforts but rather acknowledging that metrics valuing human systems are driven more by non-epistemic considerations beyond the scope of science. The success of a conservation action should ideally be assessed in a value-free framework–which can then be channeled to prompt socially valued states—as good metrics should not convey non-epistemic values.

5 Three Value-Laden, Problematic Assumptions Revealed

But does excluding human-related metrics from assessing conservation success indeed shield science from the intrusion of non-epistemic, likely-problematic considerations? Said otherwise: is the selection of traditional conservation metrics value-free and epistemically more robust than the inclusion of human-oriented metrics? This section argues for a negative response by showing that the development and selection of conservation metrics such as those displayed in Table 1 are informed by at least three questionable assumptions whose acceptance is explained by appealing to non-epistemic considerations. More specifically, I argue that when conservationists separate metrics about environmental parameters from human-related factors, they are assuming a neat demarcation between humans and the environment, that a landscape devoid of humans is the most desirable for conservation, and that human diversity is not a worthy operationalization of the biodiversity concept. Showing the value-ladeness of these three assumptions undermines the legacy of the VFI I identified above.

> Assumption 1: **There is a neat demarcation between humans and the environment.**

Metrics such as species abundance, ecosystem functionality, or percentage of protected land have been believed to measure the success or failure of conservation efforts well enough themselves. One of the assumptions at the heart of excluding metrics about human systems as value-laden is the denial that "people are intricately embedded in nature rather than apart from it" (Heller et al., 2023).

However, scientific evidence does not support a neat separation between what counts as human systems or natural systems. Research performed in recent decades (especially paleoecological research) has clearly shown that many valuable conservation sites result from the interaction of humans and their surroundings (see, for example Lyver & Tylianakis, 2017 for New Zealand; Loughlin, Gosling, Mothes, & Montoya, 2018 for the Andes; (Maezumi et al., 2018) for the Amazon). Conservation-worthy landscapes often arise from human manipulation of available resources, making the distinction between "pristine" and "managed" environments arbitrary, especially when taking a historical perspective. The Amazon forest, one of the most valuable ecosystems under discussion today, provides a prime example. The present composition of the forest has been heavily influenced by plant domestication techniques utilized by pre-Columbian civilizations. Levis (2017) showed that current Amazon tree communities have been largely determined by historical human use. Therefore, drawing a clear line between "natural" and "human-managed" areas intermingled with human livelihoods is challenging, and a more nuanced perspective that recognizes the interplay between human activities and ecological systems is necessary (Trisos, Auerbach, & Katti, 2021). Many more studies have demonstrated that current biodiversity has not developed *despite* humans, but *with* humans. Scientifically, human-free landscapes and the dichotomy of human-nature do not make much sense.

Drawing a distinction between the scope of conservation as "nature" and the scope of policy as "human system" is artificial and non-epistemically driven. Accordingly, distinguishing between human-oriented and environment-oriented metrics is explained by an appeal to an outdated ideology rooted in an account of the nature-culture dichotomy unsupported by evidence. Since clinging to this dichotomy is not ultimately supported by updated scientific evidence, the retention of the distinction is beyond purely epistemic and factual considerations. Indeed, some conservationists have described holding onto the distinction as an ideological choice and as a remnant of "a dominant Western cultural worldview that separates the category of people from the category nature" (Heller et al., 2023).

On a normative note, the resistance to including human metrics in conservation success matrices could be supported by an additional ideological premise that has historically informed conservation, which is known as the "myth of wilderness." This is the working idea that vast, untouched, and unspoiled natural areas exist without human influence or intervention, and these original states should be protected and restored. However, humans have had a significant impact on almost every corner of the planet, and even the so-called "untouched wilderness" areas are often shaped by human activities such as climate change, pollution, managed fires, and introduced species. The normativity embedded within the myth of wilderness can lead to a deceitful sense of demarcation of human-environment and can undermine efforts for conservation by preventing the adoption of metrics that better represent our knowledge of human-environment interaction.

Assumption 2: **A people-free landscape is the most desirable state of affairs for conservation.**

Another non-epistemic assumption underpinning the endorsement of traditional metrics in conservation is that the ideal conservation goal would be attained if humans could be excluded, theoretically and practically, from the environment (Dornelas et al., 2023; Mace, 2014). This is a value judgment, which is, on the one hand, rarely acknowledged as an assumption and, on the other, rarely addressed as problematic. For one, conservationists implicitly express their value judgment that achieving a people-free landscape is the ultimate goal of conservation effort in their practice of establishing ideal "conservation baselines." Conservation baselines represent conditions in which an ecosystem maintains relative stability over time and against which change is evaluated. Ecologists and conservationists are particularly interested in baselines that reflect pre-industrial conditions when ecosystems were assumed to be less influenced by human activity and, consequently, more pristine. Ecosystems in pristine conditions reflect the optimal state of biodiversity. However, it is often overlooked that baselines do not exist independently of the practice of *baselining* itself (Ureta, Lekan, & von Hardenberg, 2020). Baselining involves making prescriptive choices about what and how much to include in modeling baselines, and it is accompanied by a presumed normative value of pre-human nature, where humans are disruptive agents. By excluding metrics that measure human systems from biodiversity conservation, besides overlooking the fact that humans and the environment coproduce landscapes, we also ignore the value judgments and normativity implicated in baselining nature.

In addition, the value judgment that a people-free landscape is the supreme task of conservation manifests itself in choices of which uses of nature are legitimate in a problematic way. The establishment of protected areas for conservation aims to protect habitats from humans, but not *all* humans. Scientific research and ecotourism are often considered legitimate uses of conservation areas, while activities such as subsistence hunting and resource extraction are illegitimate uses of nature (more in Section 6). This assumption is based on a value judgment that certain human activities are disruptive to the otherwise flourishing natural environment. Choices of metrics that align with this presupposition extend value judgments to measurement practices, focusing on environmental parameters that concern ecologists rather than, for instance, benefitting other stakeholders such as local and indigenous communities.

Assumption 3: **Cultural diversity is not part of biodiversity**.

Lastly, I want to say a few words about the exclusion of human diversity, especially culture, from the conservation radar. As seen above, cultural diversity, for which some indices are available, captures the socio-cultural variability within a specific region or society. These indices consider factors such as language diversity, ethnic composition, religious conventions, and social interactions to quantify the richness of cultural identities.

"Biodiversity" is a recently-coined term, commonly characterized as comprising genetic, taxonomic, and ecosystem diversity, and is assessed through various methods already discussed by philosophers (Bocchi, 2022, Santana, 2018, Maclaurin & Sterelny, 2008). Cultural diversity is often overlooked as a component of biodiversity and is not typically included in ecology or biology publications. The exclusion of cultural diversity from the operationalization of biodiversity cannot be justified solely on epistemic grounds, as human systems and practices are inextricably linked with environmental characteristics, as we have already seen. Consequently, the decision to exclude cultural metrics as representative of biodiversity also appears somewhat arbitrary.

There is more. Consider creating metrics to assess animal cultures, such as the variety of whale songs or interspecific habits of urban birds: Few would exclude the significance of these aspects and the metrics used to monitor them for conservation (Safina, 2020). However, when it comes to human culture, even though a similar argument could be made, there is a reluctance to include them within the scope of conservation because of their supposed ethical and political status. To include one type of metric (concerning animal culture) and exclude another type of metric (human culture) from the interests of conservation, without a clear ontological distinction between the two, has elements of arbitrariness.

This is not only a terminological quibble. The characterization of "biodiversity" has implications for conservation efforts. If we define biodiversity in a way that does not include human diversity, we risk overlooking the ways in which cultural and social practices contribute to and depend on biodiversity, and may perpetuate a false dichotomy between conservation and efforts to safeguard human variability. Furthermore, by excluding human diversity metrics from conservation assessment, any loss of cultural diversity will not count against conservation success, a position that seems counterintuitive and ethically problematic.

These three non-epistemic assumptions—the separation of humans and the environment, the ideal of a people-free landscape, and the exclusion of human diversity from biodiversity—explain the resistance to including human-oriented and explicitly value-laden metrics as part of the scientific component of conservation. Since orthodox metrics are embedded with these assumptions, they are also not value-free, as the legacy of the VFI wants us to think. Instead of providing an objective assessment of conservation success, these metrics reflect the underlying value judgments that skew conservation priorities. By appealing to an alleged value-neutrality, conservationists fail to provide a sound argument as to which metrics should be considered when assessing conservation efforts.

As a last resort to justifying why the choice of traditional metrics is value-free would be to insist that conservation metrics are better described as adequate-for-a-purpose (*sensu* Bokulich & Parker, 2021) instead of being intrinsically value-laden. What is directly and properly value-laden, according to this argumentative line, is the purpose for which certain metrics are adopted, which could be a more or less explicit endorsement of the three assumptions above. Exclusionary metrics, to say it differently, might only serve the value-laden purpose of affirming the nature-human dichotomy, or the desideratum of a human-free landscape, or the exclusion of cultural diversity from biodiversity characterization. Therefore, the legacy of the VFI, namely that measurements are value-free, would still hold. However, this argument fails: an adequacy-for-purpose view about metrics is compatible with either value-laden or value-free metrics. Therefore, an adequacy-for-purpose view is irrelevant to rescuing or saving the legacy of the VFI.

I should clarify that my argument targets the specific aspect of the legacy of the VFI in connection with the alleged value-ladeness of metrics. However, here I am not trying to invalidate the VFI itself. A supporter of the FVI might reasonably argue that it is inevitable that the choice of research questions and topics is affected by non-epistemic considerations. Since metrics selection follows from a value-laden choice of research question or topic, metrics will inevitably be value-laden in this sense. The VFI would still hold, the argument goes, as long as the *form*—evidence evaluation—, instead of the *content*, of inferential reasoning is detached from any value. To bring this argument to bear on conservation metrics, VFI proponents may argue that even if traditional metrics are inherently value-laden due to their selection based on value-laden research questions or topics, the VFI still holds as long as those metrics are the ones that better represent conservation success according to the explicit purposes of conservation. In this case, conservation success can be determined purely within a value-free framework. Even if my goal in this paper is not to oppose this argumentative line, I think convincing counterarguments are available to dismiss the general claim. One is that non-epistemic considerations, such as disciplinary norms, influence the choice of evidence assessment method (see Bokulich & Bocchi, 2024). Furthermore, the argument relies on a clear distinction between the "context of discovery" (e.g. choice of questions) and the "context of justification", with only the latter requiring value freedom. However, philosophers have successfully demonstrated that there is no clear demarcation between these contexts, since the context of discovery can influence the evaluation of hypotheses and theories (Holman & Bruner, 2017; Elliott & McKaughan, 2009).[8]

[8]I am grateful to Kevin Elliott for bringing my attention to this point.

6 Scientific Colonialism

The development and choice of traditional conservation metrics are therefore not free from non-epistemic considerations. Consequently, arguments that support the exclusion of human-related metrics from the scope of conservation science based on a false demarcation between value-free and value-laden metrics are unwarranted. Pointing out the flaws underneath this argumentative strategy is not a matter of theoretical clarification alone. Serious consequences occur when the legacy of the value-free ideal discussed in this paper remains unchallenged. This section draws attention to how the exclusive use of traditional metrics relates to a phenomenon known as "scientific colonialism", namely by justifying the implementation of oppressive conservation models—usually at the expense of local and indigenous populations.

Global conservation policy is often regarded as a noble and crucial endeavor, a response to the urgent need to protect the environment and preserve biodiversity. However, beneath its virtuous facade, conservation has also been a tool perpetuating injustices. Critics of orthodox conservation practices have long noticed a connection between how, traditionally, conservation concerns ignore humans and the enforcement of orthodox models of conservation management that have promoted social harm, especially in local and indigenous communities that inhabit biodiversity-rich areas. One of the most notorious examples is a type of wildlife management called "fortress conservation." Fortress conservation is the ancestor of contemporary protected areas and has been a hardwired wildlife management model that aims to shield nature from human impact (Rai et al., 2021).[9] A successful conservation strategy, according to the fortress conservation model, fulfills the task of, for instance, bringing a nonhuman population back or down to a carrying capacity, bolstering species abundance, or improving the protection of land regardless of the condition of the human population impacted.

One of the nefarious consequences of fortress conservation has been the displacement of thousands of individuals from areas designed as biologically valuable. Environmental histories and sociological research have extensively documented how indigenous communities have been silenced and oppressed for the sake of conservation (Eichler & Baumeister, 2021) "Conservation

[9]Fortress conservation was born with the establishment of Yellowstone National Park in 1872 and was then expanded to African and Asian colonies. Promoters of this traditional model conceptualize conservation in terms of a flourishing, balanced nature free of human interference(Kricher, 2009).

refugees" is a term often used to refer to communities being displaced with the excuse that their eviction would save species from extinction or prevent ecosystems from degradation. Mark Dowie (2011) reports that 50% of the land selected for protection in the 20th century was occupied or used regularly by indigenous peoples. Although the numbers are uncertain, an estimate by Geisler and De Sousa (2001) places the number of conservation refugees on the African continent between 900,000 and 14.4 million individuals, most of whom have been evicted between 1970 and 2000. The harms local and indigenous communities have endured are countless and include, for example, landlessness, homelessness, marginalization, food insecurity, loss of traditions, social disintegration, death, exposure to diseases, and forced assimilation. Globally-reaching conservation organizations, that are predominantly based in Europe and North America, and conservationists risk perpetuating a logic reminiscent of *colonialism*, characterized by domination and exploitation over marginalized groups, when they rely solely on traditional, mostly environment-oriented parameters(Domínguez & Luoma, 2020; Adams, 2013) as relevant for conservation science.

Usually, we think of colonialism as a political and economic system where a country extends its supremacy over foreign territories, peoples, and resources via coerced settlements and the unilateral imposition of politico-social-cultural structures. However, it has often been pointed out how analogous power dynamics are still observed within scientific practices today, where privileged Western institutions or scholars assume the role of "colonial" force. This happens, for example, by imposing linguistic monopoly in the publishing sector (Politzer-Ahles, Girolamo, & Ghali, 2020) or subsidizing practices of knowledge and resource extraction without legal accountability,"parachute science" (Odeny & Bosurgi, 2022). Maintaining epistemic privilege within a select few institutions, usually located in the Global North, represents a form of epistemic or scientific colonialism (Mbembe, 2021).

At a deeper level of analysis, the colonial aspect of conservation manifests in two ways. First, conservation actions considered successful justify the "appropriation" of natural resources to support scientific endeavors such as biodiversity research. Meanwhile, activities such as educational trips and ecotourism are considered acceptable when they validate the importance of conservation areas. Conversely, local communities engaged in subsistence hunting, agroforestry, and timber extraction within delicate natural areas are often labeled as illegitimate users. Second, conservation practices also enforce "cultural hegemony" by imposing the Western scientific worldview regarding the valuation and understanding of nature, disregarding other knowledge systems. The determination of sustainable use, species protection, and desired ecosystem states exemplify ideological impositions.

Some can argue that these colonial dynamics are an unfortunate side effect of bad policy detached from conservation science *tout court*. I instead argue that the traditional conservation metrics developed by scientists justify the emergence of these injustices. Thus, science is co-responsible with policy for oppressive dynamics.

As we have already seen, metrics are technically available to quantify some of the potential harms caused by conservation actions, such as metrics developed to assess human well-being or cultural diversity (Section 4) that we encountered in Section 4. Negative well-being trends in a local community can be correlated, or even caused, by the implementation of conservation strategies. Displacing traditional communities and dismantling more-or-less ancient livelihoods to protect a valuable habitat can result in the loss of cultural diversity. It would be surprising if the contrary were the case: an analysis matching cultural diversity and biodiversity hotspots shows that "cultural diversity (proxied by linguistic diversity) has far higher overlaps with critical natural assets than does biodiversity; these areas intersect 96% of global Indigenous and non-migrant languages" (Chaplin-Kramer et al., 2023). However, no measure of well-being or sociocultural diversity appears organically in conservation performance metrics due to both the alleged scope of conservation and the value-laden nature of human-oriented metrics, making these trends invisible on the premise that human-related conditions are not valuable parameters for conservation science.

The "scientific" colonialism present within conservation science, which has historical and ideological roots, is thus reinforced by the logic of excluding human-oriented metrics from success assessment. Conservation measures that establish and maintain colonial dynamics, especially fortress conservation models and protected areas, are scientifically justified upon the adoption of traditional performance metrics only. Traditional metrics for conservation success and their privileged epistemic role act as the scientific backdrop that justifies these exploitative activities. It is not only policy that promotes forms of colonial dynamics, it is science itself that provides the foundation for exploitative practices. This aspect of conservation exposes an underlying issue in the legitimate passion and urge to protect nature, an aspect that is particularly insidious to reveal since it is concealed within layers of value freedom and unquestioned metric adoption.

6.1 Successful Conservation and Strassburrg's Prioritization Map

To illustrate the legacy of the VFI in conservation and the potential perpetuation of colonial dynamics through purportedly "value-free" metrics, this section presents a recent controversy over the selection of restoration sites worldwide to be set aside as PAs. This case study corroborates my argument that the legacy of the VFI of science around value-free metrics is alive and kicking and reveals the insidiousness of abiding by this argument.

After 2020, Upon the failure to meet critical conservation targets worldwide, the United Nations embarked on a monumental conservation campaign to reverse the loss of biodiversity. At COP 15 in December 2022, the meetings of Parties to the UN Convention on Biological Diversity endorsed the Kunming-Montreal Global Biodiversity Framework, an international treaty binding over 190 signatory countries, featuring ambitious goals for biodiversity protection until 2050. Targets 2 and 3 of the framework have come to be known as the Thirty-by-Thirty (30×30) Project, a plan to designate 30% of land and ocean as PAs by 2030, serving as a proxy for biodiversity preservation and defense. According to Article 2 of the CBD, a "protected area" is defined as "a geographically defined area which is designated or regulated and managed to achieve specific conservation objectives" (Article 2)

A prominent 2019 study connected the establishment of protected areas to the mitigation of climate change, and modeled a threshold of 30% protected land and ocean as effective in stabilizing temperature increase below 1.5 degrees Celsius (Dinerstein et al., 2019). The paper has received significant scientific and public support and constitutes the most quoted source in favor of the 30% threshold. Currently, around 15% of land and freshwater and 7% of the ocean worldwide are under some form of ecological or legal protection (Juffe-Bignoli et al., 2018). Action must be taken quickly to meet this goal before environmental degradation is irreversible.

Complementary models have been generated for the 30x30 Project to predict which sites would be more likely to pay off if placed under protection. An influential map of the Earth produced by B. B. N. Strassburg et al. et al. (Fig. 2) identifies areas of potential success in which to implement conservation strategies, especially restoration action. This study focuses on three goals that conservation action should attain:

1. avoiding species extinction;

2. mitigation of climate change;

3. cost optimization.

Conservation strategies will be successful if these goals are met, and these goals can be more easily met if PAs are established in certain regions, mostly around the equator and in high-profile tropical biodiversity hotspots. Predicting the success of restoration action, in this case, involves the use of a table that includes metrics for a biological threshold, i.e. extinction risk, and two abiotic factors, i.e. climate change prevention and economic tradeoffs. No human-oriented parameter in the sense presented in Section 4 is modeled in the map (besides cost-effectiveness, which is a parameter that goes to the advantage of investors), and human-oriented metrics are *de facto* excluded from the predicted success of restoration.

Environmental associations (such as Cultural Survival, First Peoples Worldwide, Earthrights International, and the International Indigenous Forum on Biodiversity) and conservation scientists have voiced their concerns that the 30x30 Project—as well as prioritization maps such as Strassburg's—will create a conservation model similar to fortress conservation, and will perpetrate colonial dynamics under the banner of science. For example, Strassburg's map shows an overlap between areas to be prioritized for successful restoration action and land used or inhabited by indigenous communities. This fact has generated some controversy, which materialized in a letter exchange in the journal *Nature* between the authors of the prioritization map and a team led by Forrest Fleischman. Fleischman and colleagues critically pointed out that if Strassburg's prioritization suggestions were followed literally by policymakers, then restoration efforts would likely result in compromising human's cultural inheritance and food security in a violation of human rights (Fleischman et al., 2022). The protection measures would disproportionally affect local, indigenous, and tribal communities, in whose territories 80% of total taxonomic diversity is estimated to reside, and who might be forcefully evicted. One of the points in the controversy is that Strassburg's prediction of conservation success results from

> "*normative choices to value* (that is, to optimize) relationships among biodiversity potential, carbon storage potential and cost-effectiveness, without considering the well-being and rights of people who live in areas identified as restoration priorities, nor

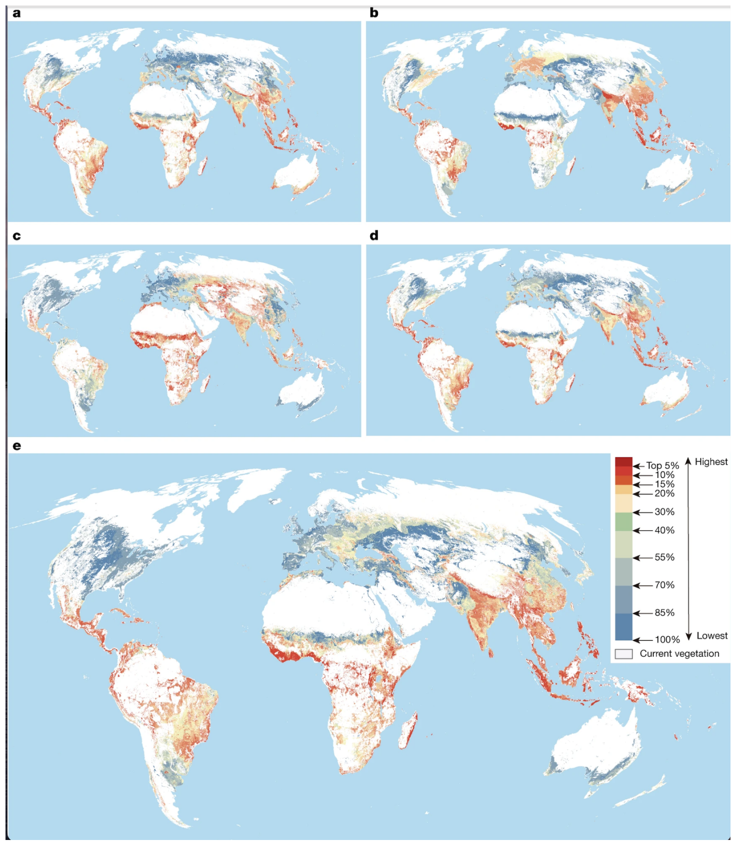

Figure 2: Strassburg and colleagues' graphic representation of areas identified as global priorities for restoration according to various criteria. The five maps display areas to be prioritized for: avoiding species extinction (a); climate change mitigation (b); cost minimization (c); preventing species extinction coupled with the mitigation of climate change (d); goals the combined consideration of avoiding species extinction, climate change mitigation, and cost minimization (e). According to the three criteria above, Strassburg's model predicts that restoration efforts placed in the red zones are more likely to be successful. Red zones often coincide with lands that are inhabited by indigenous communities, which might be displaced if establishing protected areas is the preferred strategy. [Image reprinted with the permission of Springer Nature]

the implementation costs of changing land use." (Fleischman et al., 2022, emphasis mine).

The metrics chosen for predicting conservation success and that underlie Figure 2 may exclude sociocultural measures, but, as Fleishman points out, Strassburg's maps conceptualize the success of conservation action in a way that is not value-free. More generally, one can argue that conservation metrics based on biotic thresholds and coverage goals hinge on assumptions that are normative in character and theory-laden, such that they cannot be considered value-free.

Strassburg and colleagues published a response piece defending their choice of metrics resorting to an argument that seems to be inspired by the legacy of the VFI that serves as the main focus of this paper. Although Strassburg's team clarified that their map is not to be understood as *directly* conducive to conservation measures without considering socioeconomic and ethical trade-offs, they claim that ethical and political considerations lie outside the proper bounds of biodiversity science. Strassburg et al. resist including any metrics relevant to human well-being and sociocultural diversity because

> "[in the case of] the three variables included in our analysis, the direction they should affect priority is clear—sequestering CO2 and avoiding species extinctions are positive, whereas restoration costs are negative.[...] deciding whether a given [social, ethical, cultural or political] aspect should have a positive or negative influence on the relative priority of a given area can be *arbitrary*." (B. B. Strassburg et al., 2022, emphasis mine).

In their response letter, they seem to suggest that environmental metrics and cost-benefit calculations are, unlike socio-cultural metrics, nonarbitrary, free of non-epistemic considerations, and unsusceptible to possible disagreement. To support this, they insist that the metrics chosen to predict conservation success are "scale-independent variables" (B. B. Strassburg et al., 2022) that scientists can more easily model at a global scale. On the other hand, matters of land sovereignty, sociocultural diversity, and fairness are "impossible to include" at the global level because they are subject to "local and context-specific considerations," which are allegedly the considerations of policymakers, not scientists.

Strassburg and colleagues' argument fails to adequately address the issue raised in the Fleishman letter, in my opinion. The critical letter pointed out that the three criteria utilized in Strassburg's map are inherently value-laden, meaning that other criteria and relevant metrics could have been chosen, such as metrics for the proportion of legally protected areas or indices of ecosystem health or any human-related metrics. By emphasizing the scalability of species extinction, climate change mitigation, and cost-benefit analysis, Strassburg avoids addressing the accusation that their choices result from value judgments. Defending their choice of criteria and relevant metrics by contending that when "arbitrariness" and controversy arise, global prioritization models lack epistemic robustness, Strassburg and colleagues echo the concerns that value-freedom is the hallmark of good science.

To sum up. This case study demonstrates that metrics used to evaluate conservation success are still deemed to possess greater epistemic superiority and scientific robustness when divorced from non-epistemic considerations. While estimates of environmental parameters are still the preferred metrics due to their alleged value-freedom, those metrics associated with human systems, which are susceptible to controversy and arbitrariness, are excluded from the realm of biodiversity science and relegated to the realm of policy. Furthermore, this case study substantiates my claim that scientific colonialism is not only ascribable to policymaking, but is also perpetuated by conservation science to some extent.

7 Concluding Remarks

So far, I have presented one aspect of the legacy of the VFI of science in connection with measurement practices in conservation and its implications for implementing some forms of colonial conservation models. Despite being widely rejected by many scientists, the VFI fosters the view that measurements offer a value-free, privileged representation of reality. However, value-freedom in measurement practices is contested by the revelation of how metrics are embedded not only with epistemic considerations but also by ideological, normative assumptions and value-driven choices.

A common concern that arises when considering the possible role of values in science is the worry that if science were to integrate values into its methods and procedures, it would relinquish its reputation as a reliable producer of knowledge. As a consequence, science would no longer have the privilege of influencing decision-making processes that have significant social implications. This, in turn, could lead to an allegedly highly inefficient allocation of resources or even disastrous outcomes. However, by an examination of measurement practices in conservation, I demonstrated that values already play a role, although implicitly denied. Conventional metrics are only superficially scientifically more robust—-meaning more driven by epistemic considerations only—-than human-oriented metrics because they *also* rely on concealed value-laden assumptions, such as the human-nature dichotomy, normativity of prehuman nature, and the exclusion of cultural diversity as a valid operationalization of biodiversity. These assumptions are not only value-laden, but they are also epistemically problematic. By challenging the longstanding authority of VFI in relation to measurement, we open the door to potential ethical and epistemic improvements in conservation science especially in connection with conservation measurement practices.

We do not necessarily need to step into irrevocable skepticism about metric usage, which seems unrealistic given the general trend toward a more metric-centered science (Muller, 2018). Once we have abandoned the myth of the value-freedom of conservation metrics, we can reflect on possible solutions to turn those metrics to the advantage of conservation by providing reputable and standardized ways of assessing policy while also serving ethical and societal goals. A more reflective and critical development, selection, and use of metrics might help counteract the colonial aspect of conservation.

One way to mitigate scientific colonialism via a more reflective gauge of measurement practices is to insist that human rights serve as overriding prerogatives when both environmental metrics and human-related metrics are included in a list of reliable performance metrics. Let us call it the "nature vs. human rights argument". The idea is that considerations pertaining to biodiversity loss should not supersede human well-being, particularly the fundamental rights of local or indigenous communities. The success of conservation actions cannot be deemed valid if it comes at the expense of human livelihoods, diversity, and rights. Consequently, in a list of conservation success metrics, environmental parameters are accompanied by metrics that capture human systems, with the latter given precedence when assessing the overall efficacy of a conservation strategy. This argument directly confronts the risk of scientific colonialism perpetuated under the guise of conservation, acknowledging that the objective of conservation should not be the protection of nature at the detriment of human flourishing. Notably, the prioritization of human rights in conservation has gained widespread acceptance within the conservation community and has been incorporated into international treaties and the goals of conservation NGOs in recent years.

The "nature vs human rights argument" is a guide to prioritizing human-oriented metrics in conservation success matrices—however, prioritization of this sort might not need to originate from scientific concerns but merely from ethical, social, or legal ones. An advocate for prioritizing human rights might still be a supporter of the legacy of the VFI; they might just acknowledge the significance of human flourishing while claiming that the classic metrics of conservation success can generate social oppression. However, an abandonment of the value-laden vs. value-free dichotomy around measurements does not necessarily follow. As far as this argument goes, scientific considerations might still be demarcated from policy considerations, and the responsibility for scientific colonialism would fall at the policy level when rights are not prioritized properly. Consequently, evicting indigenous communities or limiting access to biodiversity hotspots would still be justifiable conservation practices from a purely scientific point of view—even if not from an ethical or legal one—if that would protect or restore biodiversity. So, this view is not an adequate response to the problem of the value-freedom or value-ladeness of metrics, but a pragmatic solution to advance socially relevant goals.

Another solution is to completely abandon the idea that conservation performance metrics are devoid of values and instead develop success metrics that articulate many of the values endorsed by conservationists and stakeholders in a given context, including those values that have traditionally been met with suspicion. Let us refer to this as the "all metrics are value-laden arguments." This response better addresses the dismissal of the VFI's legacy concerning metrics compared to the "nature vs human rights argument." Some conservation scientists have already embraced this perspective and advocated for the inclusion of nontraditional or unconventional measurements, often derived from the social sciences (see, for example, Gruber et al., 2018 and Bennett et al., 2017). A good example in this vein has been suggested by Heller et al. (2023), who propose the incorporation of "land stewardship measurements" into the toolkit for assessing and predicting conservation success. They define "stewardship" as "an ethical and practical alternative to techno-managerial, command-and-control approaches to ecosystem care" (Heller et al., 2023) and recognize the historical and ongoing importance of stewardship practices in promoting the resilience of biocultural diversity and maintaining landscape connectivity. An ecosystem health assessment can be enriched by integrating quantifiable stewardship indicators that encompass both biophysical and social process indicators. While stewardship may pose challenges in terms of classification, mapping, and quantification, the authors argue that this type of assessment aligns with a more contemporary conservation sensitivity, one that recognizes the historical roots of conservation in colonialism and acknowledges the deep interconnections between humans and natural systems.

This second solution presents a proper response to the need to reject the legacy of the VFI as ethically and socially dangerous and strive to formulate more inclusive and epistemically robust metrics that also consider human-related systems. However, there is currently no universally agreed-upon set of metrics devised in direct response to the "all metrics are value-laden argument." Given the heterogeneity of conservation challenges, the development of a standardized list of reliable metrics might simply be implausible. Consequently, a management model derived from embracing the "all metrics are value-laden argument" is still missing, and no *singular* model is likely to emerge. Fortunately, the ultimate aim of this paper was not to advance a model for the standardization of metrics and conservation management. Rather, my goal was to uncover problematic assumptions ingrained in measurement practices and join other philosophers and scientists in problematizing the legacy of the VFI in relation to the idea of measurement neutrality.

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