

## CONTRIBUTED PAPERS

# Importance of methodological pluralism in deriving counterfactuals for evidence-based conservation

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## Abstract

Most protected area impact research that uses counterfactuals draws heavily on quantitative methods, data, and knowledge types, making it valuable in producing generalizations but limited in temporal scope, historical detail, and habitat diversity and coverage of ecosystem services. We devised a methodological pluralistic approach, which supports social science qualitative methods, narratives, mixed methods, and interdisciplinarity, to fully unlock the potential of counterfactuals in ensuring a place-based and detailed understanding of the socioecological context and impacts of protected areas. We applied this approach to derive possible counterfactual conditions for the impact of a montane protected area on 40 years of vegetation change in the Cape Floristic Region—a global biodiversity hotspot and UNESCO World Heritage Site in South Africa. We incorporated diverse methods, knowledge, and information sources, drawing on before–after protected area comparisons for inside and outside the protected area. A significant increase in shrubland vegetation (17–30%) was observed and attributed primarily to a decline in frequent burning for grazing. This also occurred outside the protected area and was driven by socioeconomic drivers and not by concerns over biodiversity conservation or land degradation. Had the protected area not been established the area would have seen intensification of cultivation and increased road networks, buildings, and water storage in dams. Our approach increased historical temporal coverage of socioecological change and contextualized assumptions around causality. Protected area impact evaluation should reengage in place-based research that fully incorporates pluralism in methodologies for constructing counterfactuals in a way that builds regional and global understanding from the local level upward. We devised 10 key principles for deriving counterfactuals grounded in methodological pluralism, covering aspects of collaboration, cocreation, inter- and transdisciplinarity, diverse values and lived experiences, multiple knowledge types, multiple possible causal mechanisms, social science qualitative methods, perceptions, perspectives, and narratives.

## KEYWORDS

before–after control–impact, context, effectiveness, interdisciplinarity, narratives, outcome, perceptions, protected

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## INTRODUCTION

Determining the impact of a protected area is an important step in evidence-based conservation and ensuring the relevance and appropriateness of ongoing conservation efforts (Sutherland et al., 2004). Protected area outcomes—such as positive or negative impacts on people, biodiversity, and ecosystem services—can be influenced by a multitude of variables that mask or mimic the impact of a protected area. Considering the plausible counterfactual conditions (i.e., the conditions that would have prevailed in the absence of protection) allows an exploration of these moderating and confounding variables of protected area impact (Pressey et al., 2015).

Counterfactuals provide plausible conditions against which the outcomes of conservation can be better interrogated and thus understood. Without explicit attention to counterfactual analyses, change in threats and associated ecosystem service impacts can be misattributed to protected area impact (Pressey et al., 2015). Crucially, to account for the inevitable complexity of conservation interventions that involve coupled social–ecological systems, the approach to deriving plausible counterfactuals needs to consider a broad range of data sets, knowledge types, and scales of relevance (Bull et al., 2021). In other words, methodological pluralism—in particular including social science qualitative approaches—is required to ensure contextualized, grounded, and detailed counterfactuals that can inform ongoing conservation efforts (Burgman et al., 2022).

Despite the growing literature on counterfactual approaches in large-scale remote-sensing-based impact studies (Bowker et al., 2017; Carranza et al., 2014; Miteva et al., 2012), their use across varied ecosystems and land-use and land-cover types has been limited (Coetzee & Gaston, 2021). In a review of 2599 publications on protected area effectiveness, Geldmann et al. (2013) found only 76 studies that used counterfactual approaches. Of these, 5 used in situ data collection, such as interviews and questionnaires or ecological, plot-based methods. The majority (89%) of studies used satellite remote sensing techniques with a focus on changes in forest cover (Geldmann et al., 2013).

Although remote-sensing-based methods remain useful, they have clear limitations. Most remote-sensing-based approaches used to derive counterfactuals draw heavily on coarse-scale data sets and generate simplified (binary natural or transformed classes) descriptions of protected area impact that may dilute effects at aggregated levels of analyses (Ament & Cumming, 2016; Geldmann et al., 2019; Miteva et al., 2012; Pressey et al., 2015). These limitations are compounded when considering that <3% of such studies use before–after and inside–outside comparisons (Geldmann et al., 2013)—which are often simplifications in and of themselves (Adams et al., 2019). Furthermore, only 5% of remote-sensing-based protected area effectiveness studies include change over >20 years for inside and outside the protected area (Naughton-Treves et al., 2005). The fact that so few of these studies engage long-term and before–after and inside–outside comparisons suggests that many of these counterfactuals may be limited in terms of social–ecological contextual depth.

Despite the limitations outlined above, current framings of evidence-based conservation—at least in the protected area impact evaluation field—consider large sample sizes and spatial coverages and emphasize quantitative data and analyses as the suitable approach to producing what is understood as credible evidence (Fischer et al., 2014). As a result, changes in multiple land-use and land-cover types and long-term changes in ecosystem services have not been adequately considered in the protected area impact evaluation literature that relies on counterfactual framings. What is more, many of these studies produce exclusively ecological counterfactuals, which do not account for the enmeshment of social factors in conservation practices and outcomes (Bull et al., 2021). We suggest that incorporating mixed-methods and social science qualitative approaches, especially narratives of impact covering confounding variables and plausible causal mechanisms, is critical to increase the credibility and scope of such counterfactual studies. For example, Jack et al. (2020) note the usefulness of qualitative narratives in integrating climate impact-related scientific evidence with local socioeconomic, environmental, and contextual knowledge, and Mitchell et al. (2015) suggest that approaches that integrate social science qualitative methods are more effective in explaining social, institutional, and system-wide changes and interactions than purely quantitative approaches. Therefore, one way to begin to address these gaps would be to draw on a fuller range of qualitative and quantitative data sources, methods, and analyses—including, for example, archival records—that are underutilized in constructing counterfactuals (Bennett et al., 2017; Fox et al., 2006; Naughton-Treves et al., 2005).

We sought to contribute to calls in the literature for participatory and mixed-methods approaches to counterfactuals and similar knowledge-cultivation methods, such as pastcasting, backcasting, scenario planning, and narratives (Bendor et al., 2021; Christie et al., 2023; Jack et al., 2020). Many of these papers speak to the importance of integrating various kinds of knowledge and data types, but in practice even when qualitative approaches are used in protected area impact evaluation they are usually forced into a quantitative framing or analysis. For example, when qualitative approaches are used in protected area impact evaluation, this tends to mean coding any qualitative data to a binary or categorical format (e.g., yes or no or a series of categories) and then converting it to a form of quantitative data (Adams & Sandbrook, 2013; Christie et al., 2023). Alternatively, the process begins from an assumption that participants will learn from the process, rather than the process will learn from participants (Robinson et al., 2011). Although any efforts to bring complex and sometimes contradictory data together should be lauded, our concern is that the detail and nuance from qualitative data are lost in this kind of processing, where one's output is yet again quantitatively skewed. What this seems to come down to is an ongoing concern around what counts as reliable evidence and how to use and present evidence reliably (Adams & Sandbrook, 2013).

Because any given counterfactual will necessarily be one of many (Bendor et al., 2021), reliance on one kind of evidence as the correct kind of evidence points to a gap between theory and

practice. We explored through a case study how methodological pluralism may be key to bridging the often-unobserved gap between the aim of counterfactual thinking (Adams et al., 2019) and the evidence and methods used to evaluate protected area impact. This is particularly of relevance to the field of protected area impact evaluation, which aims to measure actual impacts of interventions (i.e., the protected area) that have already occurred on a specific outcome variable (e.g., vegetation cover). This sets this field of enquiry apart from other approaches, such as futures thinking (e.g., forecasting, backcasting, and scenario planning), that do not necessarily aim to measure plausible past impact and attribute the role of an intervention to that impact (i.e., futures thinking does not focus on using methods in specific ways so as to closely align the results with reality as far as possible) (Bendor et al., 2021).

Methodological pluralism is a useful boundary concept that acknowledges the validity and value of multiple knowledge systems and allows for the integration of multiple concepts, all while promoting trans- and interdisciplinary approaches (Isgren et al., 2017; Olsson et al., 2015). Thus, engaging methodological pluralism in the creation of counterfactuals allows one to accept the validity of evidence on its own terms. Engaging methodological pluralism allows one to better engage more varied forms of evidence, including perceptions (Bennett, 2016), while not overlooking the often-ignored structural uncertainties, untestable assumptions, and overconfidence in inferences that come with many quantitative, especially modeling, impact evaluation approaches, including quasi-experimental approaches (Barrett, 2021).

We argue that the field of protected area impact evaluation needs to integrate methodological pluralism and socioecological approaches to increase transparency, contextual richness, and temporal depth in the construction of counterfactuals and thus provide reliable, contextual evidence on protected area impact. The value of integrating counterfactuals with methodological pluralism stems from the increased temporal, contextual, and interdisciplinary analytical diversity used to interrogate alternative outcomes, which in turn informs thinking around causality in a more contextual manner (Adams et al., 2019).

To build our argument for the critical importance of integrating methodological pluralism in the construction of counterfactuals in the field of protected area impact evaluation, we used a case study of a montane protected area in the Cape Floristic Region. We evaluated the impact of mountain protection on vegetation change by constructing the counterfactual conditions with narratives generated from qualitatively and quantitatively derived data and integrated knowledge types to interrogate how trajectories of socioecological change can mask or mimic protected area impacts on vegetation change.

We considered the usefulness of drawing on integrated methods, data, and knowledge sources when constructing plausible counterfactual conditions to ensure appropriate understanding of confounding variables and mechanisms of change inside protected areas. From our experiences in applying methodological pluralism to deriving counterfactual conditions in this case study, we synthesized 10 key principles to support methodological pluralism in research on counterfactuals for protected area impact evaluation.

## METHODS

### Case study

The Cape Floristic Region is a global biodiversity hotspot and World Heritage Site in the southwestern part of South Africa (Manning & Goldblatt, 2012). There have been substantial efforts to conserve the Cape Floristic Region over the last century, with a special focus on protecting mountain catchments and their associated water supply from the negative effects of private land use. Because these mountainous regions were a priority for conservationists in the past, they provide ideal case studies for understanding the effect of protected area establishment on specific environmental outcomes. Despite this, there has been limited inquiry into the long-term effectiveness of mountain protected areas in this region (Rouget et al., 2014).

For this case study, we used one of the Cape Floristic Region World Heritage Site protected area clusters (van Wilgen, Carruthers, et al., 2016) known as the Groot Winterhoek Wilderness Area (~300 km<sup>2</sup>; 33°3'S, 19°6'E) (Appendix S1.1). The Groot Winterhoek Wilderness Area (referred to hereafter as the wilderness protected area) is situated in the Groot Winterhoek Mountains (~800 km<sup>2</sup>; 32°38', 33°25'S and 18°56', 19°16'E), of which ~500 km are privately owned. In the past, ~200 km<sup>2</sup> of the protected wilderness was also privately owned and used for livestock grazing, wildflower and plant harvesting, and small-scale cultivation. The process of establishing the protected wilderness area started in 1962 and ended in 1978. Officially the protected wilderness was proclaimed in 1985 to protect the water supply from the catchment for downstream domestic use (Holden, 2018).

The Groot Winterhoek Mountains consist largely of sandstone–quartzitic soils with areas on and near the shale-band comprising shale or partly shale-derived soils. The vegetation is a fire-adapted shrubland, known as fynbos, which has no tree elements except in fire-protected ravines (Holden, 2018; Manning & Goldblatt, 2012). Three main vegetation units occur in the area: sandstone–quartzitic fynbos, shale fynbos, and outcrop thicket forest (Holden, 2018). Elevation ranges from 109 to 2063 m (mean 836 m) (DEA, 2016; NGI-DEM, 2016). The area has Mediterranean-type climate (cool, wet winters and hot, dry summers) (Manning & Goldblatt, 2012). Mean annual rainfall is ~742 mm (range: 353–1776 mm) (Water Resources, 2012).

### A methodologically pluralistic approach to exploring counterfactuals

To examine the impact of the protected wilderness area, we used a methodologically pluralistic approach that promoted local land owner and practitioner longitudinal perceptions and perspectives and integrated data and knowledge types with a focus on in-depth, place-based, and landscape-level analyses (Appendix S1.2). We aimed to determine protected area impact in relation to the broader mountain socioecological system (Appendix S1.2). Our study design was approved by the Faculty of Science Research Ethics Committee, University of Cape Town (code PSREC 04–2015).

A core step in this process entailed conducting site visits and having discussions with key actors working and living in the landscape to identify variables and relevant methodological approaches on which to focus the protected area impact evaluation. In this way, the approach used to evaluate the protected area impact was cocreated with a mix of 16 key actors, including landowners and conservation and mountain management organizations. Variables and methods were discussed with these key actors in relation to the main components of a typical directed acyclic diagram for protected area impact evaluations, including treatment, mechanism, moderator, confounding variables, and outcome (Ferraro & Hanauer, 2015). Fire and vegetation were identified as important outcome variables. Land-use and land-cover changes were identified as key potential mechanism effects of the protected area, which would have resulted in changes in fire and vegetation. Climate was identified as a potentially important moderating effect.

The identified variables were then explored further through in-depth unstructured interviews with 60 landowners, use and examination of archival records, field visits and ecological surveys, and other desktop-based research methodologies (e.g., remote-sensing based). Use of these methods ensured a variety of temporal and spatial scales were examined, the inclusion of multiple forms of data and knowledge, and the integration of empirical evidence with lived experience and on-the-ground insight.

To construct the counterfactuals for the protected area, we needed to be able to determine changes in actor-identified variables and mechanism effects and to understand the role of the protected area alongside other confounding and moderating variables in driving change in the identified outcome variables. To do so, we used methods and concepts drawn from social sciences, ecology, historical ecology, sustainability sciences, land-change science, and conservation science. This included using 3 main concepts to frame the way we understood change and plausible causal mechanisms of change: socioecological systems (Fischer et al., 2015), ecosystem services (Costanza et al., 2017), and land-use transitions (Foley et al., 2005) (Appendix S2). We used the following methods (Appendix S3): before–after protection comparisons of descending point vegetation surveys and oblique photography to examine ~40 years of change in vegetation cover and composition inside the protected area; before–after protection orthoimage comparisons inside the protected area to examine change in fire occurrence and describe plausible causal mechanisms of change in vegetation cover and composition and fire observed; analysis of climate station data to determine potential moderating variables not influenced by protection; before–after protection orthoimage comparisons outside the protected area on land with terrain similar to inside the protected area to quantify potential counterfactual land-use and land-cover conditions for the protected area; comparison of results of a survey of present day private landowners (60 respondents who owned land outside the protected area on similar terrain) and results of the same survey conducted in 1978 (83 respondents) to quantify potential counterfactual land-use and land-cover conditions that could not have been detected through remote sensing

imagery alone (e.g., nature-based recreational activities, grazing, wild plant harvesting, and ecotourism); and in-depth interviews with 60 landowners who owned land on terrain similar to the protected area but outside the protected area to further explore counterfactuals for the protected area with a focus on determining confounding variables that could have driven change other than the protected area. The methodological details for each of the methods above, including the questionnaire used for survey and in-depth interviews, are in Appendices S3–S5.

Methodological pluralism helped us integrate multiple methods, data, disciplines, knowledge streams, and theories to inform how we applied counterfactual thinking boundaries (Olsson et al., 2015). This included integrating perceptions of landowners into plausible causal mechanisms of change in the landscape outside the protected area. To do this, we used the concepts of socioecological systems (Fischer et al., 2015), ecosystem services (Costanza et al., 2017), and land-use transitions (Foley et al., 2005) to provide blended operational boundaries and multiscale perspectives that allowed us to interrogate findings of socioecological change outside the protected area and from this to construct plausible counterfactual conditions for the protected area impact evaluation. This detailed examination of the processes around and impacts of protected areas in turn allowed for more contextualized and relevant understanding of the conservation efforts.

We used remote sensing and interpretive social science approaches to provide important quantitative and qualitative linking methods for incorporating multiple methods and knowledge and information sources into the investigation of protected area effect. Increased historical temporal coverage was achieved through historical orthoimages and social surveys and interviews, among other methods that aimed to provide fine-scale place-based information on potential changes in ecosystem service use over time. Empirical evidence generated from the analyses of repeat vegetation surveys, terrestrial oblique photographs, orthoimages, and quantitative landowner survey questions provided quantifiable measures of change. Qualitative in-depth landowner knowledge in contrast allowed us to capture the complexity inherent in socioecological system dynamics, such as cross-scale dynamics, and thereby allowed for exploration of plausible causal mechanisms for change in quantitative measures.

We harnessed qualitative social-science methods (e.g., drawing on thematic analysis and narratives for analysis) for the integration of knowledge sources and the synthesis of the potential counterfactual conditions for the protected area impact evaluation. We focused on using a narrative and qualitative text in a table format as the analytical tool to synthesize the protected area impact analysis result. We did this to reduce the risk of losing important detail and nuance and misattributing impacts to variables that, after extensive qualitative research, turned out to be less relevant than other (perhaps less obvious and less easily quantifiable) factors. We therefore present a narrative of the main findings in terms of protected area impact along with a table that summarizes these main findings.

From reflecting on the process of applying a methodological approach to this case study and in relation to existing relevant

**TABLE 1** Mean and range of percent change in canopy and basal fynbos and outcrop thicket-forest vegetation cover after 37 years of protection.

| Method           | Vegetation unit        | Cover type | Mean (range) change (%) | Statistic value                                   |
|------------------|------------------------|------------|-------------------------|---------------------------------------------------|
| Descending point | Shale and hydromorphic | Canopy     | +30 (+8 to +38)         | $\beta = 1.5 \pm 0.1, \chi = 14.99, p < 0.0001$   |
|                  |                        | Basal      | +24 (+19 to +47)        | $\beta = 1.29 \pm 0.07, \chi = 16.46, p < 0.0001$ |
| Line intercept   | Outcrop thicket forest | Basal      | +17 (+10 to +33)        | $V = 0, p = 0.03$                                 |
|                  |                        | Canopy     | -29 (-55 to +0.5)       | $V = 14, p = 0.13$                                |
|                  |                        | Basal      | +4 (+2 to +8)           | $V = 0, p = 0.06$                                 |

Note: Private land use was removed from consideration (also see Appendices S3, S4, & S6).



**FIGURE 1** Example of a historical (left, 1970) and relatively recent (right, 2013) photograph set showing the increase in vegetation cover of restioid sedges, decreases in bare areas and rocks, an overall increase in the height of vegetation, loss of taller reseeded *Protea laurifolia* and resprouting *Protea nitida*, but notable increases in juvenile *Protea* spp., including *Protea repens* after 40 years of protection. Historical photograph by R. A. Haynes and repeat photograph by S. Jack. Image sets for all sites are in Appendix S6.4.

literature proposing similar approaches, we devised key principles for supporting a methodological pluralistic approach in protected area impact evaluations (see “DISCUSSION”).

## RESULTS

### Vegetation history

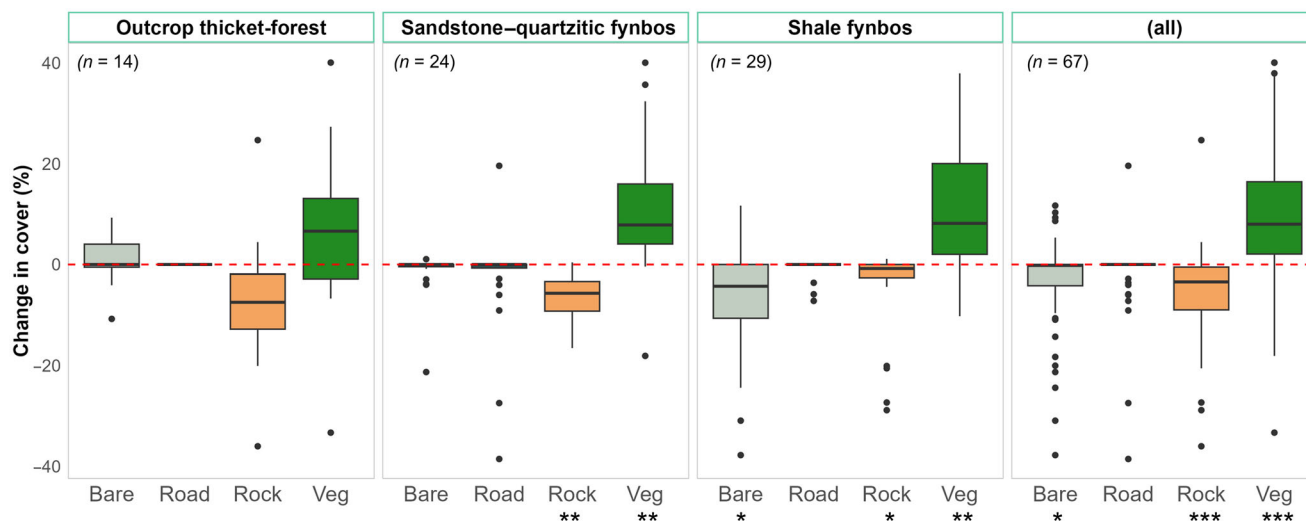
Vegetation cover increased in the protected area on average by 17–30% (range: 8–47%), depending on the method (Table 1; Appendix S6). Shrubs increased mostly in shale fynbos sites, whereas hydromorphic sites largely showed increases in restioid sedges (Table 1; Figure 1; Appendices S6.2–S6.4). Changes in outcrop-forest thicket sites were small, not consistent, and not significant (Table 1; Appendix S6.5).

Based on repeat photographs, vegetation cover increased, bare ground decreased, and exposure of rock and roads was

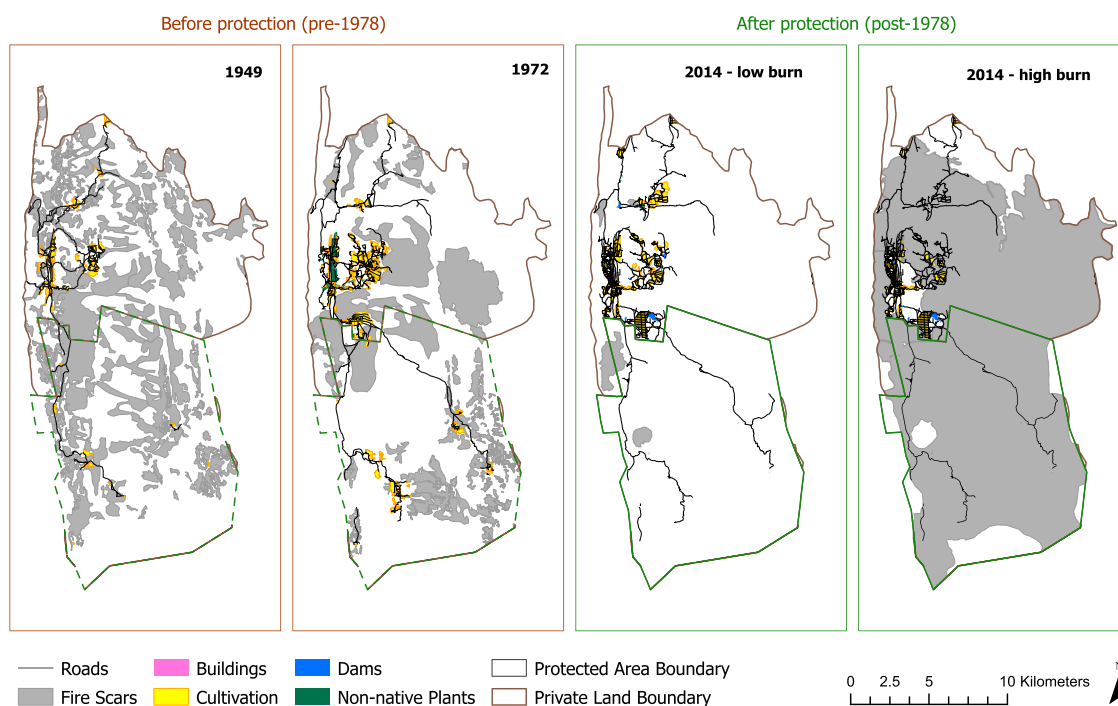
unchanged. For outcrop thicket forest, there was also no clear trend (Figure 2; Appendix S6.6). Based on qualitatively derived photograph analyses, changes were represented by a loss of taller reseeded *Protea* spp. individuals and pioneer species (e.g., *Stoebe plumosa*) and increases in juvenile reseeded *Protea* spp. (*Protea repens* and *Protea laurifolia*), resprouting *Protea* spp. (e.g., *Protea nitida* and *Leucadendron* spp.), and nonproteoid shrubs and restioids. For outcrop forest thicket, only consistent increases were observed for pioneer species, such as *Stoebe* spp. (Appendices S6.4, S6.6, & S6.7).

### Land use and fire history (1949, 1972, and 2014)

Prior to protection, the area covered by dams, buildings, roads, cultivation, and non-native plants increased from 1949 to 1972 inside and outside the soon-to-be protected area (Figure 3; Appendix S7.1). After protection (1972–2014), the develop-



**FIGURE 2** Change in land cover for 67 paired historical (1970 and 1978) and recent (2013–2016) photographs (all - vegetation [veg]:  $V = 230$ ,  $***p < 0.0001$ ; bare ground [bare]:  $V = 895.5$ ,  $*p = 0.01$ ; rock:  $V = 1617.5$ ,  $***p < 0.0001$ ; road:  $V = 47$ ,  $p = 0.21$ ; Sandstone-quartzitic - veg:  $V = 14$ ,  $**p < 0.001$ ; bare:  $V = 50$ ,  $p = 0.08$ ; rock:  $V = 275$ ,  $**p < 0.001$ ; road:  $V = 23$ ,  $p = 1.05$ ; Shale fynbos - veg:  $V = 41$ ,  $**p < 0.001$ ; bare:  $V = 291.5$ ,  $*p < 0.01$ ; rock:  $V = 236$ ,  $*p < 0.01$ ; road:  $V = 6$ ,  $p = 0.63$ ; Outcrop thicket-forest - veg:  $V = 18$ ,  $p = 0.22$ ; bare:  $V = 26.5$ ,  $p = 4.1$ ; rock:  $V = 83$ ,  $p = 0.06$ ; road: no roads in photos) horizontal lines, medians; bar ends, interquartile range; whiskers, minimum and maximum 1.5 above and below interquartile range; dots, outliers in 4 land-cover classes).



**FIGURE 3** Land-use and land-cover maps showing changes in fire scars and land-use types (2014 high burn shows all fires that occurred from 2009 to 2013; 2014 low burn shows all fires that occurred from 2004 to 2008) for privately owned land (private land boundary) and for the protected Groot Winterhoek Wilderness Area (protected area boundary) in the southwestern Cape of South Africa, before and after protected area establishment in 1978.

ment of dams, buildings, roads, and cultivated fields continued to increase outside the protected area, whereas inside the protected area these declined. Non-native trees declined after protection inside and outside the protected area. Outside the protected area and after protection, the area converted for water storage purposes (as dams) and for buildings increased exponentially, whereas the rate that areas were converted to

cultivation slowed (i.e., from 250 ha in 1948 to 515 ha in 1972 to 579 ha in 2014). Dams also increased in number and size outside the protected area after protection (Appendix 7.2).

Prior to protection (1949 and 1972), there was a high frequency of small fires across the landscape. More recently (2004–2013) after protection, infrequent extensive fires burned

**TABLE 2** Private land-use change since 1978 in the Groot Winterhoek Mountains outside the protected wilderness area in the southwestern Cape of South Africa.

| Variable                  | Private land use      | Direction of change | 1978 (%) | 2016 (%) | $\chi^2$            |
|---------------------------|-----------------------|---------------------|----------|----------|---------------------|
| Percentage of respondents | Ecotourism            | +                   | 5        | 28       | 13.54 <sup>a</sup>  |
|                           | Personal recreation   | +                   | 2        | 63       | 68.16 <sup>b</sup>  |
|                           | Wild plant harvesting | –                   | 29       | 23       | 0.55 <sup>d</sup>   |
|                           | Grazing               | –                   | 41       | 20       | 7.01 <sup>c</sup>   |
|                           | Cultivation           | +                   | 12       | 32       | 8.29 <sup>c</sup>   |
| Percentage of area        | Ecotourism            | +                   | 1        | 11       | 4542.5 <sup>b</sup> |
|                           | Personal recreation   | +                   | 0.1      | 17       | 9520.5 <sup>b</sup> |
|                           | Wild plant harvesting | –                   | 20       | 7        | 2482.6 <sup>b</sup> |
|                           | Grazing               | –                   | 34       | 8        | 9210.5 <sup>b</sup> |
|                           | Cultivation           | No change           | 2        | 2        | 0.33 <sup>d</sup>   |

<sup>a</sup>df = 1,  $p < 0.001$ .<sup>b</sup>df = 1,  $p < 0.0001$ .<sup>c</sup>df = 1,  $p < 0.01$ .<sup>d</sup>df = 1,  $p > 0.05$ .

large expanses of the protected mountain catchment (Appendix S7.3). These trends were evident inside and outside the protected area.

Over the last ~40 years (from 1978 to 2016) outside the protected area, personal recreation and ecotourism increased and grazing and wild plant harvesting declined (Table 2). Similar to the orthoimage analysis, surveys with landowners showed that there was no change evident in the extent of area under cultivation, but the number of landowners who cultivated their land increased (pointing to a subdivision of farm portions).

Narratives (Appendix S5.2) confirmed a substantial reduction in grazing, increases in personal nature-based recreation and ecotourism, and a shift to larger and more intense fires. They also supported the finding that cultivation intensified with little change in the extent and, despite increased water-use efficiency per unit area, the amount of water stored on the mountains for irrigation increased (Table 3; Appendices S5.3 & S8).

Landowners described the landscape outside the protected area in the early 1940s through to the 1970s as being dominated by livestock-based, subsistence agriculture and small-scale fruit farming. This was then described as transitioning to agricultural intensification on the lowlands and small portions of the mountains and the use of the mountains as recreational lands from the mid-1990s and early 2000s to the present. One landowner summarized these changes as there being “a switch from an agricultural landscape used for pasturing stock and also fruit trees, apples and pears, to cut flowers and recreation, mainly private and friends, with also some tourism-based recreation” (Table 3).

Landowner perceptions as to why land-use change occurred outside the protected area were in summary as follows: increased living standards and wealth, environmentalism, technology innovation and transfer, market fluctuations, and intrinsic ecological constraints. They were grouped into 3 generic land-use transition pathways: economic growth, globalization, and natural resource scarcity (Table 3; Appendix S8).

The overarching finding from our in-depth interviews with landowners was that land-use change in the mountains outside the protected area was driven primarily by socioeconomic factors, including socioeconomic benefits related to globalization and economic growth. Despite abandoning mountain land for grazing, increased living standards and wealth and the rise of environmentalism resulted in the continued use of mountain land for ecotourism and private nature-based recreation land-use types (Table 3; Appendix S8).

## Climate history

No changes were evident for total annual rainfall, but total summer rainfall declined. There were increases in both annual and seasonal maximum and minimum mean temperatures except for winter maximum temperatures. Annual mean monthly wind run declined in all seasons, but there were no trends in evaporation, except declines in spring evaporation (Appendix S9).

## DISCUSSION

### Narrative of the counterfactual conditions for informing protected area impact

Results from our repeat vegetation surveys showed an increase in canopy and basal vegetation cover, suggesting that the protected wilderness area had a positive impact on protecting local vegetation. However, to fully understand the influence of the protected wilderness, we needed to determine whether the improvement in vegetation conditions could be clearly linked to the establishment of the protected wilderness area. Developing the plausible counterfactual conditions that might have developed in the absence of the protected wilderness area was key

**TABLE 3** Summary of change in land use and plausible causal mechanisms of change derived from 15 thematic narratives of socioecological change (Appendix S5.2) generated from in-depth interviews with landowners in the Groot Winterhoek Mountains.

| Change in land use and plausible causal mechanisms of change                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Related landowner quote                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Landowners indicated that in the past they had used their mountain land for grazing but now had shifted their attention to intensification of cultivation of other crops such as citrus and wine on their lowland properties. Intensification of cultivation on the mountains also occurred and included a shift from stone fruit to high-income crops such as berries.                                                                                                                                                                                                                                                     | <p>"It was a lot of fruit farming in the past and then it became less and less as the years went on."</p> <p>"In these days...we are farming with citrus and wine."</p>                                                                                                                                                                                                                                                                                                                                    |
| Landowners indicated that in the past they were actively burning the vegetation every year. The main purpose of the burning practices was to stimulate new growth of vegetation for their goats, sheep, and cattle, which were using the mountain extensively. Reduction in grazing in the mountains also resulted in the direct reduction in the use of fire in the mountains.                                                                                                                                                                                                                                             | <p>"In the past, every year the mountain was patch burnt. This happened in the past for at least 100 years. There was always very different aged vegetation on the mountain."</p> <p>"In the past there were a lot of goat paths everywhere in the mountains and the vegetation was always open and easy to walk through."</p>                                                                                                                                                                             |
| Many landowners noted an increase in "lifestyle farmers" in the catchment, who did not use the land for any economic purposes. Certain landowners had also diversified their livelihoods by investing in ecotourism avenues.                                                                                                                                                                                                                                                                                                                                                                                                | <p>"Most people that come to the mountains do not want to make a living, they want to be in nature."</p> <p>"There has been in general a growth of tourist sites in the mountains."</p>                                                                                                                                                                                                                                                                                                                    |
| Landowners described a shift to larger and more intense fires, especially since the late 1980s.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <p>"Now when the mountain burns, the whole mountain burns. This has been happening for the last 30 years."</p>                                                                                                                                                                                                                                                                                                                                                                                             |
| Livestock production in the mountains in the past provided only a marginal income, and domestic animals were used primarily to provide food for families and workers. An increase in wealth and living standards were important perceived causal mechanisms that reduced the use of mountain land for grazing. There was no longer a need to rely on the mountains for subsistence livestock production. The priorities were now on areas and agricultural practices that could provide sufficient financial returns.                                                                                                       | <p>"The grazing was for my father and us, it was our income, we were poor."</p> <p>"I think the biggest reason that they stopped burning and grazing the land was [because] living and farming conditions changed. So as soon as they were able to cultivate the lower slopes, they stopped using the mountains for grazing because it was easier to just use the lower slopes and it made more financial sense."</p>                                                                                      |
| As a result of national conservation-orientated predator management policies that were passed in the 1990s, landowners could no longer manage damage-causing wild animals (primarily jackal and caracal) through lethal management, such as hunting and poisoning. This resulted in a greater perceived risk of keeping livestock in the mountains due to a perceived increase in the occurrence of predators in the mountains and a reduction of the use of the mountain for grazing.                                                                                                                                      | <p>"In the past we had hunting clubs and we would all go out and hunt these problem animals. At this stage it was legal to hunt them."</p>                                                                                                                                                                                                                                                                                                                                                                 |
| Landowners indicated that reduced fire use linked to reduced grazing activities and active fire suppression had resulted in the build-up of vegetation biomass and the development of extensive, high-intensity fires.                                                                                                                                                                                                                                                                                                                                                                                                      | <p>"In these days the vegetation grows extremely tall and very thick. This causes very large vegetation fires which burn extensively and hot. It is a big problem for us and for the mountain."</p>                                                                                                                                                                                                                                                                                                        |
| Landowners that aimed to cultivate their mountain land had to adopt productive and efficient agricultural technologies due to the water requirements of new crops and the ecological constraints of mountain land. Increased water-use efficiency increased crop production but not the area cultivated. Although water-use efficiency per unit area had been improved primarily because of a shift from flood or sprinkler irrigation to drip irrigation, there was still an overall need to store water on the mountains. This coupled with advanced technologies increased the number and size of dams on the mountains. | <p>"You need a lot of water resources to farm up here, it is really just washed-out sandstone and is very porous."</p>                                                                                                                                                                                                                                                                                                                                                                                     |
| During the mid-1990s and throughout the 2000s, there was an increase in market demand for certain high-income and luxury crops.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <p>"In these days, things have changed, we are farming with citrus and wine and we can make much more money than in the old days."</p> <p>"It was a lot of fruit farming in the past and then it became less and less as the years went on. Then it was changing over because the market prices were good."</p>                                                                                                                                                                                            |
| Many landowners had stopped harvesting wild plants from their mountain properties because of a drop in the market price. The reason for the collapse in the market was due to low populations of sought-after species, which resulted in poaching and unsustainable harvesting levels, which impacted further on the size and ecological health of most wild populations.                                                                                                                                                                                                                                                   | <p>"We tried to do a sustainable harvest, but we were forced to do it in a non-sustainable manner because of the poaching that was occurring each year."</p> <p>"The price just plummeted. It is all in the oil, there is a toxin in the oil of the one low-quality plant, so Europe did not want it and there was not enough of the high-quality species anyway."</p>                                                                                                                                     |
| Growing environmentalism, together with increased living standards and wealth, at local, national, and global scales also resulted in a greater appreciation and demand for nature-based recreational activities. This resulted in landowners diversifying their livelihoods to accommodate the new demand for nature-based recreation by tourists. It also resulted in landowners or their families and friends using their own properties for nature-based recreation. Furthermore, individuals from nearby cities and towns had enough money to buy land for purely nature-based recreational reasons.                   | <p>"It was not fashionable in the past to visit natural areas or protected environments. Society now needs to get out of the city. This desire for natural areas is much higher than in the past."</p> <p>"For me as a young man I did not value this connection with getting out of the city and away into natural areas."</p> <p>"With the increases in environmental awareness and demand for mountain land for tourism and also from a protection point of view, the land has increased in value."</p> |

(Continues)

**TABLE 3** (Continued)

| Change in land use and plausible causal mechanisms of change                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Related landowner quote                                                                                                                                                                                                                                                                                                                                                                                                               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The reduction in fire use was exacerbated by the rise in appreciation of nature-based recreation because there now was a reluctance to burn the vegetation because of aesthetic reasons. The reduction in fire use resulted in a perceived increase in vegetation cover, which resulted in an increase in the perceived risk of large and intense fires in the landscape. This resulted in a policy shift in which the management and liability of fires were moved to landowners as opposed to the state (the National Veld and Forest Fire Act 101 of 1998 replaced certain sections of the Mountain Catchment Areas Act, see 2.1 for more details). This further reduced fire use in the landscape due to lawsuits associated with a fire moving from one property onto another.                                          | "We are too scared to burn anymore because of the financial risks of a fire moving from my property to my neighbors."                                                                                                                                                                                                                                                                                                                 |
| The occurrence of large and intense fires in the landscape also influenced changes in cultivation. For example, the large fire of 1994 resulted in many landowners selling their land or portions of their land due to loss of income as a result of the destruction of fruit orchards and other infrastructure. Certain portions of land were sold to lifestyle farmers who bought purely for nature-based recreation and leisure activities and certain landowners diversified their livelihoods by investing in ecotourism avenues.                                                                                                                                                                                                                                                                                       | "The 1994 December fire destroyed many orchards and they just never picked up again and those farms, or certain portions of farms, were sold for lifestyle farms."                                                                                                                                                                                                                                                                    |
| Fire was also closely allied to perceptions of how water flow had changed in the catchment over time. Fire was seen as both a negative and positive influence on water flow from mountain properties. A correct balance of vegetation and fire was seen as critical to sustain flows and prevent soil erosion in the mountains and other related damages. Limited fire use and the subsequent increase in vegetation cover were cited as reasons for a decline in water from the mountains in recent years. The view that the catchment was being burnt in unplanned and large fires was considered a mechanism of soil erosion and was also perceived as being damaging to local and regional water supplies through sedimentation of dams and water transfer canals and increases in water purification efforts and costs. | <p>"If there is a patch mosaic of vegetation on the mountain there is always certain components of the vegetation that can hold on to the rain when it falls. It can then be used for cultivation and the natural vegetation, but also can be slowly released to downstream dams."</p> <p>"The fire was very hot so burnt everything. It was a mess when it started to rain because there was nothing to hold the soil in place."</p> |

here, as was situating its impacts within both local and global contexts. The evidence gathered and the layered process of constructing a counterfactual drawing on methodological pluralism are summarized below and in Table 4.

For our case study, climate trends observed over the last ~40 years pointed to a negative effect of climate on plant growth and vegetation cover. Similar to previous analyses (Hoffman et al., 2011; MacKellar et al., 2014; van Wilgen, Goodall, et al., 2016), we found an increase in hot, windless days and a decline in rainfall in summer months. Hot, dry, and windless conditions are particularly challenging for plants in the region (Cramer et al., 2014; West et al., 2012). Despite this, recovery of vegetation cover after fire was quicker than before protection. Therefore, although it is likely that climate played a moderating role and may have even reduced rates of vegetation recovery, our integration suggested that it was not the dominant force shaping change in vegetation cover over the last 40 years.

Like other Mediterranean shrubland ecosystems, vegetation in the Cape Floristic Region is strongly influenced by fire (Slingsby et al., 2020; van Wilgen, Carruthers, et al., 2016). The results of our mixed-methods approach showed that burning in the protected wilderness was far more frequent prior to the 1970s, primarily because a system of patch burning was used to rejuvenate and improve the vegetation for livestock. With frequent fires comes lower fire intensities (van Wilgen, Carruthers, et al., 2016). Repeated, frequent, and low-intensity burning keeps biomass low and can result in the loss of certain

reseeding shrubs, accompanied by the proliferation of certain resprouters favored by frequent fires, such as restioid sedges (Kraaij et al., 2013; van Wilgen, 1982; van Wilgen & Forsyth, 1992; Vlok & Yeaton, 2000). This was clearly shown for the vegetation change results in our case study. Our combined findings suggested that with the removal of domestic livestock, and the related cessation of frequent, low-intensity fires in the protected wilderness area, the vegetation recovered and that there was an overall increase in vegetation cover dominated by shrubs, including reseeding proteoids and other nonproteoid shrubs, in areas previously heavily used for grazing and by restioid sedges in waterlogged areas.

Trends for vegetation, observed in the protected wilderness area along the shale-band—an area often used for grazing because of its more productive soils (Holden, 2018)—clearly showed the shift from frequent, low-intensity fires prior to the 1970s to a regime with a longer fire return interval and an increase in fire intensity. The integration of our findings therefore suggested that the increase in vegetation cover in the protected wilderness occurred primarily because land-use practices, such as burning and grazing, were prohibited in the conservation area. However, in terms of a counterfactual argument regarding the impact of the wilderness protected area on vegetation cover, the question remains as to whether subsistence activities would have been sustained in the area into the 21st century if the protected wilderness had not been established.

**TABLE 4** Change in land use and cover, fire, and vegetation after protection in 1978 for areas outside and inside the currently protected mountain area (protected wilderness area [PA]).<sup>a</sup>

| Variable           | Before protection (1940s–1970s)                                                                                         |                                                                                                                                                                                                                                              | After protection (>2010s)                                                      |                                                                         | Change pathways                       |                                       |
|--------------------|-------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|-------------------------------------------------------------------------|---------------------------------------|---------------------------------------|
|                    | Inside and outside wilderness protected area                                                                            | Outside wilderness protected area                                                                                                                                                                                                            | Inside wilderness protected area                                               | Outside wilderness protected area                                       | Inside wilderness protected area      | Outside wilderness protected area     |
| Ownership          | Privately owned land                                                                                                    | Privately owned land                                                                                                                                                                                                                         | State owned land                                                               | Privately owned land                                                    | Environmentalism                      | Environmentalism                      |
|                    | Burning for grazing and wildflower harvesting                                                                           | Personal nature-based recreation and ecotourism <sup>b</sup>                                                                                                                                                                                 | Regulated (permit-controlled) nature-based recreation                          | Personal nature-based recreation and ecotourism <sup>b</sup>            | Increased living standards and wealth | Increased living standards and wealth |
| Land use and cover | Extensive cultivation in suitable areas of mountain land                                                                | Cultivation intensified in areas of suitable mountain land <sup>b</sup>                                                                                                                                                                      | Some access roads and buildings but reduced in comparison to before protection | Cultivation intensified in areas of suitable mountain land <sup>b</sup> | Intrinsic ecological constraints      | Intrinsic ecological constraints      |
|                    | Roads, buildings, dams, and non-native trees near settlements                                                           | Exponential increases in buildings and dams <sup>b</sup>                                                                                                                                                                                     |                                                                                | Exponential increases in buildings and dams <sup>b</sup>                | Market growth and collapse            | Market growth and collapse            |
|                    | Almost zero nature-based recreation or ecotourism                                                                       | Linear increases in roads <sup>b</sup>                                                                                                                                                                                                       |                                                                                | Linear increases in roads <sup>b</sup>                                  |                                       |                                       |
| Fire               |                                                                                                                         |                                                                                                                                                                                                                                              | Some non-native trees but reduced in comparison to before protection           |                                                                         |                                       |                                       |
|                    |                                                                                                                         |                                                                                                                                                                                                                                              | Poaching of certain wild plants                                                |                                                                         |                                       |                                       |
|                    | Small, frequent, and low-intensity fire regime due to the use of burning for grazing and the presence of low fuel loads | Landscapes switches between a high- and low-intensity fire regime due to the limited use of burning and accumulation of high fuel loads                                                                                                      |                                                                                |                                                                         |                                       |                                       |
| Vegetation         | Patch work of small to medium fire scars (~30–120 ha) across the landscape, that is, 144–297 fires over a 5-year period | Years with few (<5) large (~3080–4700 ha) high-intensity fires burning almost all (78–92%) of the vegetation followed by years with smaller (~90–123 ha), infrequent (<5) low-intensity fires burning very limited portion (~2%) of the area |                                                                                |                                                                         |                                       |                                       |
|                    | 22–34% of the area burnt over 5-year period                                                                             |                                                                                                                                                                                                                                              |                                                                                |                                                                         |                                       |                                       |
|                    | Large fires are rare                                                                                                    |                                                                                                                                                                                                                                              |                                                                                |                                                                         |                                       |                                       |
| Vegetation         | Patch mosaic of vegetation age ranging between 1 and 5 years                                                            | Homogenous vegetation age across large portions of the mountain catchment varying from 1 to 15 years                                                                                                                                         |                                                                                |                                                                         |                                       |                                       |
|                    | Low vegetation cover and open canopies                                                                                  | High vegetation cover compared to before protection with closed shrub canopies after 5 years of vegetation recovery after high-intensity fires (in areas not fragmented by land use—see last row below)                                      |                                                                                |                                                                         |                                       |                                       |
|                    | Fragmentation of vegetation due to land use including livestock paths, roads, cultivation, and related infrastructure   | Pockets of very old vegetation due to biophysical conditions excluding fire                                                                                                                                                                  |                                                                                |                                                                         |                                       |                                       |
| Vegetation         | Pockets of very old vegetation due to the lack of suitability for grazing or biophysical conditions excluding fire      | Reduced fragmentation of vegetation in comparison to before protection                                                                                                                                                                       |                                                                                |                                                                         |                                       |                                       |
|                    |                                                                                                                         | Increased fragmentation of vegetation due to increases in buildings and roads and related infrastructure <sup>b</sup>                                                                                                                        |                                                                                |                                                                         |                                       |                                       |
|                    |                                                                                                                         |                                                                                                                                                                                                                                              |                                                                                |                                                                         |                                       |                                       |

<sup>a</sup>Findings summarize results from 100 interviews, repeated vegetation surveys and ground terrestrial photographs, and historical and current orthomosaic analyses. The main inferred plausible causal mechanisms of change are summarized in the last column for and outside the protected area.

<sup>b</sup>Outcome avoided inside the wilderness protected area due to protected area establishment.

Evidence from outside the protected area clearly showed that grazing and patch burning would have not continued into the present day regardless of protected area establishment. For example, drawing on our detailed findings including before–after comparisons outside the protected wilderness area for privately owned mountainous land with similar biophysical characteristics, it was evident that there were substantial declines in subsistence grazing activities since the 1970s. This included a decline from 34% of the privately owned mountain catchment being used for grazing to only 8% over the last ~40 years. Insights from in-depth interviews with 60 landowners suggested that this decline was influenced mainly by socioeconomic drivers, including socioeconomic benefits related to globalization and economic growth, and not by concerns over local land degradation or resource depletion due to grazing activities. This is a critical insight that was only garnered through the deployment of methodological pluralism, such as integrating detailed, on-the-ground findings with each other throughout the research process, which strengthens an iterative process of evidence finding.

Over the last ~40 years, there was a substantial increase in dams, buildings, and roads and intensification of cultivation outside the protected area on private mountainous land. This was avoided inside the protected area, where these land-use and land-cover classes declined (Table 4)—even though these land-use and land-cover classes increased inside the protected area before protection similar to outside the protected area. If these activities had been allowed to proliferate within the main water catchment area of these mountains, it is likely that improvements in vegetation cover would have been fragmented and water quantity and quality could have been reduced for downstream users.

One potential impact is that the avoided dam building in the mountain catchment ensured a steady supply of water to the water supply system that supports the City of Cape Town. This is because water leaving the protected wilderness is diverted into a canal to a water impoundment that is a critical source of water to the Western Cape Water Supply System—an integrated system of 6 large water impoundments that supply water to the metropolis (58%), agriculture (26%), and smaller towns and nearby municipalities (6%), with ~10% lost to evaporation (Wolski, 2018). Some of this water would have been locked in dams on the mountain land for private use, which has been shown via physically based hydrological modeling (Holden, 2018).

Therefore, in comparison with the 1970 baseline measures, our results suggest that this proclamation has been positive for the vegetation in terms of avoiding fragmentation from land-use activities and avoiding infrastructure building, such as roads, buildings, and dams.

## Ten key principles of methodological pluralism

Our results highlight the usefulness of methodological pluralism in understanding and contextualizing long-term protected area

impacts. Overall, our results showed how global and local contexts (such as increased market access, abandonment of land for grazing, fire policies, etc.) interacted to produce the landscape as it is now. Although vegetation increased, it was not directly attributable to protected area impact. An avoidance of infrastructure building that would have fragmented vegetation cover and potentially negatively influenced water leaving the protected wilderness was attributable to the protected area.

We showed how methodological pluralism can be engaged to produce complex, nuanced, and more contextualized counterfactuals for exploring conservation impact. These findings signal the value of recognizing key principles for supporting methodological pluralistic approaches in protected area impact evaluations. Based on our findings on applying methodological pluralism and on the usefulness and practical applications of methodological pluralism in creating counterfactuals, we propose 10 key principles that can support a rigorous, pluralistic, socioecological approach at multiple levels of analyses.

First, use participatory or collaborative approaches with a diverse group of actors to determine the focus of conservation impact evaluation studies (i.e., including what variables to focus on and how to interrogate these while carefully balancing knowledge–power dynamics in this process). Second, allow the variables identified to guide the methods drawn upon from a methodologically pluralistic conservation impact evaluation toolbox. Third, consider a range of disciplinary, interdisciplinary, and transdisciplinary methodologies and analytical approaches in this methodologically pluralistic conservation impact toolbox (i.e., embrace trans- and interdisciplinarity but do not lose sight of core disciplinary strengths, standards, processes, and approaches where required). Fourth, incorporate the need for operational boundaries but include multiscale perceptions and perspectives. Fifth, accept the limits and boundaries of knowledge in that it is not possible to give a complete, analytical, and formal description of a complex problem. Sixth, acknowledge the role of humans and in particular values, beliefs, and lived experiences in designing and implementing interventions and experiments and in measuring, recounting, describing, designing, and interpreting change or impact, including individuals, society, researchers, and decision makers. Seventh, combine multiple forms of logic and knowledge for uniting or deliberating aspects of different traditions between disciplines (including deep disciplines) or different individuals or groups of society and for informing one or more theoretical models. Eighth, recognize that multiple theories exist to describe causal mechanisms of socioecological change and ultimately there are many theories on how society can transition to sustainability. Ninth, focus on implementation and local solutions enabled through detail and specification but allow for aggregation of specifics for the purpose of generalization. Tenth, embrace the importance of social science qualitative methods, including perceptions, stories, and narratives (from diverse groups of people and individuals) in understanding why things change and in driving change.

Social science methods offered within a methodologically pluralistic approach provide useful linking frameworks that

show protected areas are already integrated with surrounding socioecological landscapes and offer important points of entry around conflict and success. Many authors are concerned that, despite best efforts at integration, protected areas are often managed as islands within a matrix of degraded territory with no clear conceptual framework to integrate them in the surrounding social landscape (e.g., agricultural, business, and cultural landscapes). This isolation is perceived by many as a risk to the ability of protected areas to persist into the future, particularly when competing with other land-use demands (Cumming, 2016; Palomo et al., 2014). We encourage bringing in a diverse group of key actors directly into the conservation impact evaluation process from the start in the form of collaboration while balancing knowledge power dynamics in the process (principle 1) (McClure, 2023). This goes deeper than just identifying the need for protected area effectiveness studies to track both social and ecological outcomes and their interactions (Ghoddousi et al., 2022).

Our findings for this protected wilderness were clear: with regard to the counterfactual argument around the impact of the mountain protected area, the positive change in vegetation cover was not attributable to the establishment of the protected area alone. Rather, these changes were linked to broader factors—increased opportunities, globalization, and access to the market economy; better living standards; improved economic growth; and greater infrastructural development—which in turn influenced shifts observed, such as farmland abandonment, increased nature-based recreation and tourism, and decreased grazing and change in use of fire in the mountains. This insight was garnered from integrating the principles of methodological pluralism that emphasizes multiscale perceptions and perspectives (principle 4), takes seriously various forms of methods, logic, and knowledge (principles 2, 3, & 7), acknowledges operational and knowledge boundaries (principles 4 & 5), and includes the role and experiences of humans in the socioecological landscape (principle 6) (Cilliers, 2005; Cockburn, 2021; Flood, 2010; Lam et al., 2012; Meyer & Lunnay, 2013). Importantly, these principles of methodological pluralism ensure that impact evaluations do not just look at one-way flows (e.g., global to local) or interactions between binary or categorical classes, but rather explore narratives of the complex interactions and potential trade-offs that exist in an integrated and contingent socioecological landscape (principles 5 & 8) (Foley et al., 2005; Jack et al., 2020; Peter & Swilling, 2014).

To promote long-term sustainability, multiple systems and interactions need to be considered when assessing protected area impact (principle 8). In our case study, increased water storage and fragmentation outside the protected area were described by landowners to have also brought increased socioeconomic opportunities, such as employment and local opportunities for ecotourism and sustainable agriculture (Holden, 2018; Holden et al., 2021). These local socioeconomic benefits have been prevented inside the boundaries of the protected area. In other words, the seemingly negative ecological effects of vegetation fragmentation brought positive socioeconomic outcomes outside the protected area. Understanding tensions and opportunities, and how they may affect support for conservation, is

critical in long-term sustainability. These interactions highlight the need for multiple land-management systems that are continuously informed by local, regional, and global contexts that take into account socioeconomic trade-offs, as well as socioecological feedbacks and constraints (Lambin & Meyfroidt, 2010). This is supported by principle 8, which recognizes that there exist multiple theories and perspectives on how society can transition to sustainability (Peter & Swilling, 2014).

Methodological pluralism, as we propose it, begins to address the risk of protected area isolation and irrelevance (Bennett et al., 2017; Coetzee & Gaston, 2021; Fox et al., 2006; Naughton-Treves et al., 2005) by providing counterfactuals that integrate the detailed impacts of protected areas into a broader understanding of their socioecological landscapes (principle 9) (Flood, 2010). Our results make it clear that a multitude of variables can influence the impact of conservation in mountain environments and that there are numerous challenges in measuring and attributing these impacts. Importantly, many of the factors influencing potential impact may have gone undetected using conventional or singular quantitative methodologies, especially because some of the key land-use types (e.g., wildflower harvesting, grazing, personal nature-based recreation) in this mountain system are undetectable from satellite imagery (Holden et al., 2021). In our case, methodological pluralism meant that a greater range of methods, timescales, and modes of analysis were used, which has produced an illustration of some of the complexity inherent to a real-life, shifting, and relational environment (principle 10) (Bennett, 2016).

Drawing on the counterfactual argument at a place-based level, as we did, is just one step toward fully understanding the contextual impacts of protected areas on biodiversity, ecosystem services, and human well-being, especially when considering benefits and burdens at local and regional levels between social groups both spatially and temporally. Further theoretical and empirical work could attempt to increase understanding of the role of methodological pluralism in creating relevant, contextually rich, and transparent conservation evidence. We believe that these principles should be used and refined as required to inform an approach to consistently collect site-level data on conservation interventions, in a way that supports locally appropriate and contextualized conservation, while providing evidence to further generalize understandings at global level (principle 9) (Flood, 2010).

We call for a refocus on place-based research that engages fully with methodological pluralism in the design of protected area impact evaluations and that draws on counterfactual approaches. We call for greater acknowledgment of the importance of the local social, biophysical, economic, and temporal contexts of individual protected areas in protected area evaluations at broader aggregated levels. To ensure that evaluations use the appropriate data at the appropriate scale of analysis, interdisciplinarity, especially incorporating social and natural science approaches, is required (Bennett et al., 2017; Miteva et al., 2012). This message aligns with recent global calls for conservation to reengage with contextually rich knowledge that uses place-based findings to build regional and global understanding (Wyborn & Evans, 2021).

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## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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