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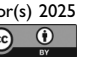

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Legitimacy in the making: Conservatism, additionality and natural capital accreditation in the UK's Woodland Carbon Code

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Abstract

This article critically examines the Woodland Carbon Code (WCC), the quality assurance test for UK woodland carbon credits. Drawing on ethnographic fieldwork and interviews with stakeholders in the Scottish land sector, we show how the WCC's finance allocation, additionality criteria, and carbon measurement systems create legitimacy for the code, the credits the code generates, and the market on which the credits are traded. The paper begins by tracing the early history of the WCC to describe how the code's developers integrated a commitment to *calculative conservatism* into its design. We then consider how WCC developers responded to a *trial of legitimacy*. Stakeholders argued that the existence of WCC-accredited commercial timber plantations, which should not have passed its economic additionality criteria, revealed flaws in the WCC's accreditation process. The ensuing threats to the code's legitimacy were exacerbated by broader concerns about the mixed socio-ecological record of natural capital markets worldwide. We then analyse the additionality demands introduced to the code to exclude forest ecologies deemed undesirable from receiving carbon finance. These tweaks were made to shore up the code's legitimacy and to maintain the long-term functioning of the voluntary carbon market. These dynamics are constitutive of the three main claims we make in this article. First, that ecological, political, and scientific forces interact in natural capital markets in ways that threaten the legitimacy of the commodification process by creating undesirable outcomes. Second, that operators of accreditation schemes reflexively respond to these reputational risks by changing the way

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they measure nature, allocate credits, and direct finance towards particular carbon offsetting projects. Third, that the (il)legibility of nature is, in part, an emergent effect of the way political and cultural pressures bear down on the practices of scientific representation and economic valuation rather than something that is inherent to the ecologies being represented.

Keywords
Carbon markets, legitimacy, Scotland, forests, natural capital

Introduction

In November 2024, the UK Government's Department for Energy Security and Net Zero launched a public consultation. Stakeholders from the business, finance, farming, and environmental sectors were given until July 2025 to offer their opinions on a new policy and governance framework designed to ensure that voluntary carbon markets and biodiversity offset markets are high integrity. The term 'high integrity' promises many things: that the natural capital credits are trustworthy for publics, investors, and civil society; that the measurement systems are accurate and do not overcount, miscount, or double-count; that additional ecological and climatic improvements are being delivered; and that local and rural populations benefit from the projects being created. The UK government are investing political capital into developing these high integrity markets to differentiate themselves from the voluntary natural capital markets in other regions that have faced widespread criticism over the last twenty years. These criticisms have called into question the accuracy of their measurement systems (Lohmann, 2011), their ambivalent ecological outcomes (zu Ermgassen et al., 2023), the way they can concentrate power in elite hands (Carton and Andersson, 2017; Stanley, 2024), their role in driving land grabbing (Fairhead et al., 2012), the ways they delay more radical climate action such as mitigation (Carton et al., 2023), their role in sustaining consumption (Lovell et al., 2009), and the numerous cases in which credits not linked to genuine ecological or climatic change have been sold (West et al., 2020).

In the consultation's initial report, the UK Government frames itself as a global leader in addressing climate change and nature loss. This confidence is partly derived from the careful controls it has put in place to regulate natural capital markets. The Woodland Carbon Code (WCC) is the flagship accreditation system for the UK's voluntary carbon market and is at the heart of the government's pursuit of high integrity markets (Scottish Government, 2024). It is the most widely used natural capital accreditation system in the UK, and combines a set of legal, measurement, and governance procedures which determine if a forest can receive carbon credits that can be sold on the voluntary carbon market. It also determines how many credits a forest can receive.

Third-party accreditation schemes such as the WCC help assure publics, offset brokers, buyers, and governments that natural capital offsets have catalysed genuine ecological, climatic, or social change. Like other accreditation programmes used in socio-environmental markets, including organic labels and fair-trade badges (Goodman, 2010; Roe, 2006), accreditation schemes introduce transparency into supply chains. They make ecological complexities 'legible' and investable to the state and the market (Scott, 1998) by stabilising the material world into fixed, tradable, and accountable units (Robertson, 2006). These stabilisations help mediate between the actors, ecological dynamics, political discourses, capital flows, and scientific representations held together in market-based solutions to climate change and biodiversity loss. In doing so, they create *legitimacy* for natural capital markets by assuring different actors that financial investments correspond to desired environmental change (Lansing, 2012). Over the course of the paper, we use the term legitimacy to refer to the assent, given by relevant stakeholders whose assent is needed, that a particular

socio-technical arrangement is appropriate and acceptable from the position they each occupy in the market (Blum 2020).

Critical scholars examining neoliberal approaches to environmental governance have explored how the design and delivery of natural capital markets are dependent on a range of sophisticated measurement technologies (Christiansen, 2024; Stanley, 2024) and metrics (McElwee, 2017). They have problematised the way in which the apparent objectivity of these quantifications can obscure the subjective assumptions and calculative partialities necessary for creating offsetting calculations (Cooper, 2015), and they have highlighted these markets' mixed ecological and justice outcomes (Nost, 2015; Nost and Goldstein, 2022; Stanley et al., 2025; Turnbull et al., 2022). The less spectacular work involved in keeping these markets alive, however, has largely been taken for granted. Our aim in this paper is to fill this gap by answering two interlinked questions: how do natural capital accreditation systems secure and maintain legitimacy over time? And how do accreditation systems co-produce markets, ecologies, and politics?

By answering these questions, we contribute to wider debates in political ecology and science and technology studies (STS) around how natural capital markets are maintained through ongoing technical, discursive, and performative work (Callon, 2009). We show how the owners and operators of accreditation schemes respond to claims that the offset market they facilitate is having undesirable social or ecological consequences, as well as to the political pressures created through the ambivalent outcomes of offset markets more generally. This maintenance work is achieved by altering the way their scheme allocates credits, the way it channels carbon finance to specific projects, and the way it materialises specific ecologies. Legitimacy is brittle, in other words, and a continual patchwork of fixes, undertaken by accreditation scheme operators, is needed to keep the market alive. If offset markets constantly move between being contested (where people argue that certain considerations have been overlooked and that undesirable outcomes are being produced) and concerned (that they are adapting to take relevant socio-ecological issues into account) (Valiergue and Ehrenstein, 2022), then accreditation schemes become the place where those negotiations are staged. Legitimacy is an ongoing acheivement, always in the making.

These dynamics are constitutive of the three main claims we make in this article. First, that ecological, political, and scientific forces interact in natural capital markets in ways that threaten the long-term functioning and integrity of the commodification process by creating undesirable outcomes. Second, that the operators of accreditation schemes reflexively respond to these reputational risks by changing the way they measure nature, allocate credits, and, in turn, enable finance to flow towards certain reforestation projects. This sustains both the legitimacy of the accreditation scheme under scrutiny, the credits it creates, and the market it underpins. The third conclusion to be drawn from these interactions is that, contrary to diagnoses offered in the debate so far (e.g., Markusson, 2022), the (il)legibility of nature is, in part, an emergent effect of the way political and cultural pressures bear down on the practices of scientific representation and economic valuation rather than something that is inherent to the ecologies being represented. It is a function of the political, economic, and scientific atmosphere in which relevant actors deploy certain metrics and protocols to represent the world in specific ways. The point here is that the accreditation schemes that translate ecosystems into fungible credits respond to public and political preferences for which natures are being deemed desirable and which must be made legible and investable.

To elaborate these claims, we pay close empirical attention to the WCC as it touches down in rural Scotland, where the woodland carbon market has grown significantly over the previous five years (Sharma et al., 2023). The empirics for this paper are based on fieldwork conducted between April 2021 and November 2022 by the lead author. These engagements consist of ethnographic research across rural Scotland (April-September 2021; March-April 2022) and 61 interviews with a range of stakeholders in the Scottish land sector. Interviews were conducted with the WCC's creators, developers, current and former board members, and its users, including

landowners, forest managers, carbon brokers, rewilding NGOs, community forest groups, state departments, and private forestry companies.

In the following section, we review STS and political ecology literature to reflect on the role legitimacy plays in natural capital markets. In section three, we trace the history of the WCC's early development and describe how the WCC's developers pursued a commitment to what we term *calculative conservatism* as part of their bid for legitimacy. In section four, we introduce the notion of a *trial of legitimacy* to analyse an accusation levelled at the WCC: that its economic additionality criteria were not stringent enough and that already-profitable commercial timber plantations were wrongfully being granted carbon finance. To fix these concerns, tighter additionality mechanisms were introduced. We explore these responses in section five.

An important part of the argument we develop in this paper is that the maintenance of legitimacy in natural capital accreditation schemes, and the credits and markets they underpin, is an ongoing challenge. The sectoral controversies we describe in this paper, along with the WCC scheme updates they inspired, must be read as an inevitably partial chapter in an incomplete story. To this end, we use the paper's conclusion to reflect on the future of the UK's high integrity natural capital markets and highlight areas where future controversies and updates might take place.

Legitimacy in offset markets

For forests and other ecologies to be made legible (Scott, 1998), commodifiable (Lansing, 2012), and governable (Gabrys et al., 2022; Urzedo et al., 2022), they must be 'translated' (Latour, 1993) into stable, discrete, and enumerable units. Metrics and technologies transform material forests into political-ecological entities (Devine and Baca, 2020; Peluso and Vandergeest, 2001). Messy ecosystems thick with variation become items in spreadsheets, figures in a graph, or offset credits in an emissions inventory (Robertson et al., 2023a, 2023b). These representations are objects that can be traded, known, and governed far from the site of their ecological referent (Cusworth and Stanley, 2025).

The coordination of various actors is needed to performatively create such representations in a way that allows them to enter the circuits of exchange or be subjected to some other form of governance (Robertson, 2012). The process involves, in the first instance, a spatial demarcation (Lansing, 2012). In carbon forestry projects, fences, GPS coordinates, and photographs effectively cordon off the ecologies that fall outside frame and thus the trees and carbon that remain within (Gifford, 2020). Metrics then help create a reproducible method with which different forests in different locations can be represented in commensurate terms (McElwee, 2017). These provisions are designed to both convince relevant actors of the legitimacy of the representations they are generating, *and* to demonstrate the legitimacy of the platform on which those representations are exchanged (Lansing, 2012).

There is no inherent trait to the qualities that yield an adequate, convincing, and legitimate representation. The test is whether the representation is endorsed by the different actors held together by a given scheme (Robertson, 2012, 2006). A purchaser of a carbon offset credit must, for example, be generally convinced that a correlative amount of carbon has been stored as a result of their purchase and that the carbon has not been sold elsewhere in a double-counted credit (Lippert, 2015). Actors involved in the creation of an offset credit are strategic and reflexive about the fragile link connecting representation to reality (Cusworth et al., 2022). In carbon offset schemes and other green financing projects, metric developers use high-tech and sometimes spectacular measurement apparatus to convince investors and state actors of the legitimacy of their carbon calculations (Stanley, 2024).

In natural capital and carbon offsetting markets, the tools and standards used to organise an environmental governance scheme or offset market determine which natures get made, where

they get made, and who benefits from their creation (Robertson, 2006). These tools have 'environment-making agency' (Cusworth and Stanley, 2025) in that they materialise the natures that are legible and valuable according to the logics of their representational processes. These measurement schemes are the means through which broad political commitments and problematisations are mobilised. Net zero commitments have, for example, imbued carbon sequestration with a unique political and economic appeal (Carver, 2023). Against this political and calculative backdrop, planting uniform, fast-growing trees can often be more profitable than protecting mature forests which sequester less *additional* carbon (Palmer, 2020). Attracted by the exciting new financial opportunities associated with tree planting and carbon offsetting, some project developers and landowners who have little experience with forest creation are increasingly moving into the forest creation space, which can shut down opportunities for smaller nature restoration organisations benefitting from the new opportunities these markets afford (Stanley et al., 2025).

As we explore more below, the material consequences of a measurement system's design reveal the performative impacts of its metrics and measures. These performative creations prompt scheme operators to experiment with their accreditation scheme's design to ensure its attractiveness for future investors. The legitimacy of a credit (the thing that allows it to enter into the circuits of exchange and governance) is, we show, continually being (re)evaluated in relation to these performative ecological outcomes. This is one of the main points we draw out in this paper, and one that has been under-articulated in the literature, so far. Going beyond the now familiar conclusions that 'metrics make worlds' and that 'the materiality of the world exceeds the calculative frames used to represent them', we show that that the metrics that allow markets to function must account for the materiality of forests in ways that service what that market's legitimacy conditions are. There is not therefore a unidirectional influence of metrics-shaping-natures, but a recursive loop in which the metrics used to measure ecological change and the ecologies that get made as a result co-produce one another (Cusworth and Stanley, 2025). The point, then, is that the (il)legibility of nature is always, in part, determined by preferences that get projected onto natural capital markets concerning which natures are being deemed desirable, and thus which must be made legible by the accreditation process.

For these reasons, the legitimacy of a natural capital accreditation system is not solely secured by proving that its measurement systems operate with absolute accuracy (Cooper, 2015). Legitimacy is also produced by presenting the 'high quality' or 'boutique appeal' of a given environmental project (Valiergue and Ehrenstein, 2022). Here, strategic appeals are made in reference to the multiple benefits that natural capital projects deliver and the 'charisma' (Wang and Corson, 2015) or 'virtue' (Paterson and Stripple, 2012) this confers on the credits being produced. Strategic and reflexive bids for legitimacy in this representational process form an important part of the discussion we offer below on the WCC: the conservatism, undercounting, and standardised measurement embedded into the WCC's design are all strategies that can be understood in these terms.

Bids for legitimacy must also contend with broader economic and political forces. These conditions form the backdrop within which offsetting and environmental governance projects unfold and vie for stability. The growing rap sheet of failed or flawed environmental offsetting projects (West et al., 2020; zu Ermgassen et al., 2023) and the perpetually elusive nature of international environmental targets are prompting policy makers to innovate with new forms of governance and regulatory design (Blum, 2020). For this reason, accusations that environmental governance programmes, subsidy schemes, and offsetting markets have marginalised the voices and worldviews of a diverse set of stakeholders has led to a boom in policies designed with 'co-production' elements (Turnhout et al., 2020). In the way they synthesise the problematic outcomes of disparate environmental governance schemes and offsetting markets (Beunza and Ferraro, 2019) and in the way they communicate those findings to different publics and governmental actors (Blum, 2020), NGOs play an

important role in shoring up the legitimacy of a scheme, particularly as market operators respond to changing political conditions.

This dynamic - in which macro-level political pressures and expectations impinge on accreditation scheme operators and scheme metrics - forms an important part of our analysis of the WCC. They are layered on top of (or set the context for) the more specific contestations that arise from the way an offsetting accreditation system allocates finance and materialises specific ecologies. In the contemporary politics of socio-ecological crisis, local, global, and networked connections create spatially complex modes of engagement and responsibility (Cusworth, 2023). For this reason, schemes like the WCC help (re)produce a market-friendly form of environmental politics (Kolinjivadi et al., 2017), just as the legitimacy of the design and delivery of the WCC has been, and continues to be, conditioned by the broad political, economic, and ecological context in which it operates.

Calculative conservativism: the origins of the WCC

The UK's voluntary carbon market, and the WCC used to accredit it, did not arrive from nowhere. They were created through discursive, technical, and metrological work performed by a range of stakeholders finding the common ground needed to establish a market legitimate enough to be investable (Callon, 2009; Cooper, 2015). In this section, we describe the emergence of the WCC and explain how and why scheme operators inscribed a commitment to *calculative conservatism* into the code from its very earliest formation as part of their bid for legitimacy.

In an interview, John (pseudonym) – a carbon broker and forester who helped to develop the WCC through the mid-2000s – explained what lay behind WCC's inception. He described how the idea to sell UK-based forest carbon came to him in 2006 when his commercial forestry business started working with a car insurance broker who wanted to sell carbon offsets to the drivers they insured. John realised that a code of conduct was needed to maintain the legitimacy of the carbon credits he was selling. If, he explained, the market was flooded with bad practices and bad actors, the legitimacy of the whole market, including his offsets, would fall apart. With the Director of ConFor, the trade association for the UK forestry industry, John consulted with the UK Forestry Commission (the state forestry department) to develop a code of conduct for forest carbon accreditation. After a period of consultation between the WCC's designers, forestry experts, and economists, the WCC was piloted in 2010 and launched in 2011.

The WCC was created to bring state-backed legitimacy to the woodland carbon credits which private companies were beginning to generate in the late-2000s and early-2010s and sell on the UK's voluntary carbon market. The rules which the WCC lays out – rules that a forestry project must follow to be accredited – were designed to stabilise the legitimacy of the credits produced. All forest creation projects accredited by the WCC must follow the UK Forestry Standard (UKFS), a set of state-backed regulations which apply to all forest creation projects in the UK. For example, tree planting cannot take place on soils over 50 cm deep to ensure large soil carbon stocks are not lost.

The WCC also sets out measurement protocols to ensure that the number of carbon offsets generated is sufficiently credible. This credibility, as several key stakeholders in the UK carbon market stressed, is crucial for the woodland carbon market to garner public support. For example, John explained that,

> The credibility of the code [is] sacrosanct because without an absolutely robust unshakeable Woodland Carbon Code… our operation and the value of the carbon finance in supporting new woodland creation would be completely blown away.

Much like the design of other carbon accreditation and measurement schemes, the WCC's measurement protocols are not the neat outcome of scientific consensus about how to best quantify forest carbon. Such agreement, as many critical scholars have highlighted, is impossible to achieve given the subjective choices that must be made when deciding how to represent diverse ecological systems and the variation that characterises them (Gifford, 2020; Lippert, 2015; Lovell, 2014). The WCC's measurement protocols, as with other carbon measurement systems (Cusworth et al., 2022) and natural capital accreditation schemes (Cooper, 2015), can be understood as the outcome of this exact type of metrological contingency and contestation. Its measurement systems were 'scavenged' (Robertson et al., 2023a) by an alliance of state, private, and research actors repurposing relevant knowledge infrastructures in the name of a new natural capital market.

The WCC Carbon Calculation Spreadsheet is the central mechanism used for quantifying woodland carbon credits. Offset producers populate the spreadsheet with information about a project's start date, its expected duration, the species planted, the area planted, and so on. The spreadsheet calculates the "long-term average carbon stock that is projected to accumulate on the site" and subtracts from that figure the "emissions resulting from the preparation of a site prior to planting" (Woodland Carbon Code, 2022: 20). The precise numbers which the spreadsheet generates confer a sense of epistemic realness to the credits generated (Porter, 2021), as they have been produced through an ostensibly neutral, impersonal, and state-backed measurement apparatus (Goldstein, 2022).

In generating its credits, the WCC follows a two-step process: validation and verification. At the validation stage, which occurs before the forest has been planted, the WCC predicts the amount of carbon a woodland project is expected to sequester, based on carbon prediction and monitoring tools developed by Forest Research (the UK Government's forest research organisation). Upon validation, projects can be accredited with Pending Issuance Units (PIUs), which are effectively credits sold with a promise to deliver future carbon sequestration.

Woodland creation projects must be *verified* by an independent body five years after planting and then every ten years (at years 15, 25, 35, etc.), to confirm that the trees are growing as planned and the carbon is being sequestered. At the time of writing, the two independent bodies who can verify are the Soil Association (a national food and farming charity) and Organic Farmers and Growers (the UK organic certification body). They have been accredited by the UK Accreditation Service, a national accreditation body recognised by the British Government.

When they have been verified, the PIUs are translated into Woodland Carbon Units (WCUs), which can be bought and sold as carbon offsets for UK-based businesses and are displayed on the online platform, the UK Land Carbon Registry. This two-step process of validation and verification brings legitimacy to the credits. Validation ensures that specific rules and regulations have been followed, whilst verification guards against the risk that offsets are sold without a correlative amount of carbon being materially sequestered, thus reassuring purchasers that their offsets are more than just 'virtual' (Huff, 2021).

Aware of the reputational risk of selling offsets for carbon that had not been actually sequestered, the developers of the WCC inscribed two *undercounting* protocols into the WCC methodology. Doing so guards against the possibility of mistakenly selling credits that do not correspond to any material change (i.e., stored carbon). If the WCC produces excess carbon sequestration beyond the number of credits sold, many interviewees argued, then all the better for the legitimacy of the credits the WCC *does* produce. An investor can rest assured that their investment into a forest might even sequester *more* carbon than they paid for. This sense of legitimacy is a collectively achieved feat – one that emerges as a consensus from the diverse actors the WCC holds together (Koronka et al., 2022).

When generating PIUs, the WCC spreadsheet subtracts 20% from its initial carbon calculations. These will gradually be paid back as the project is subsequently verified. A further 20% is taken away, which are kept permanently in the Scottish Forestry buffer account to safeguard against

overcounting, miscalculation or uncertainty within carbon science. These are fears which many market sceptics in Scotland hold (Stanley, 2024).

An employee of the WCC provided a helpful example:

1. A project is predicted to sequester 1000 tonnes of CO2e over 100 years.
2. 20% will be removed temporarily to be conservative, leaving 800 units (PIUs).
3. 20% of these will be permanently removed and stored in the Scottish Forestry buffer. Therefore 640 PIUs are assigned up-front.
4. If the trees grow as expected, the 200 units originally set aside will be gradually given back to the project when it is verified. Although 20% of these will be added to the Scottish Forestry buffer.
5. If everything grows as planned, 800 units (WCUs) will be given to the project, even if 1000 units were sequestered.

In short, this means that even if the trees grow exactly as planned and it has been estimated that the forest has sequestered 1000 tonnes of carbon dioxide, only 800 carbon credits can ever be sold. The conservative buffer accounts for the inherent variability of the material process through which carbon is locked up into trees, and the difficulty of ever measuring forest carbon with certainty over extended timelines (Gupta et al., 2012). This calculative conservatism, developers and users of the WCC explained, was an anticipatory and strategic attempt to head off potential criticism that the WCC overestimated and overallocated its offset credits, a phenomenon that has been widely reported on in other regions (West et al., 2020). Several interviewees working for carbon brokerage and forestry companies argued this calculative conservatism is crucial for the establishment of a high integrity market: one that, unlike many REDD + projects (Frewer, 2021), sold carbon credits that delivered genuinely additional forest growth. Rather than present the WCC's calculations as entirely accurate, a claim which would be subject to close technical critique, legitimacy is established and maintained by privileging conservative undercounting instead of optimistic overcounting.

There was generally support for this approach amongst actors in the carbon brokerage sector, whose employment depends on buying and selling carbon credits. For example, one carbon broker praised the WCC for the way it mitigates against

> [The] risk of slight uncertainty and the lack of measurability and any inaccuracies in the model and the models… [by deducting] I think it's 15% [sic] from its calculations for uncertainty. You then lose another 20% to a buffer, slightly to guard against the permanence of your carbon reduction.

Such a perspective is important for understanding the WCC from the position of those whose industries buy and sell its credits. Here, carbon measurements are presented as scientifically informed, based on the state's finest available datasets (Forest Research's calculations). But equally the fallibility of woodland carbon measurement is never denied. It is an appetite for imprecision (Ghosh, 2019) driven both by pragmatic concerns about the availability of the tools needed to apprehended complex forest ecologies (Robertson, 2006) and by a desire to strategically insulate the WCC and its credits from claims of calculative foul play. The WCC's measurement might be considered in David Lansing's terms (2012) as a 'reflexive performance' as its users and developers negotiate the technical difficulties in accurately measuring the carbon stored within a forest, whilst maintaining a pragmatic commitment to using natural capital markets to scale up private investment in forest creation.

Alongside undercounting, the WCC also employs a *standardised* approach to measuring carbon sequestration in a way that is appropriately conservative. When a project manager calculates the

number of PIUs the project can generate at the validation stage, they must use fixed-data inputs (for inputs such as tree species, the spacing between the trees and the site's altitude) in the WCC's Carbon Calculator spreadsheet. In effect, an individual forest developer cannot quantify how much carbon a specific forest can generate based upon their own calculations: the WCC spreadsheet's columns determine these results according to standardised patterns. This ensures that the same carbon quantification processes apply universally to every forest creation project. There becomes less space for exaggerated or miscalculated carbon credits, which shores up the shared legitimacy of the credits. In interviews, carbon brokers who used the WCC assured us that standardisation offers an improvement on other forest carbon accreditation schemes. Standardised measurement protocols help the WCC to evade the accusations of fraud, cronyism and data fudging that haunt carbon offsetting projects elsewhere in the world (Carton et al., 2020; Valiergue and Ehrenstein, 2022).

Within this standardised measurement system, the WCC derives its calculations of carbon sequestration from well-established datasets about tree growth. These are largely based on research related to what commercial foresters, in interviews, widely referred to as the "standard practices of forestry" (specific species, types of planting, spacing between trees, etc.), for which there is extensive data, generated over decades of study. As Nick, an employee and representative of the WCC, described in an interview,

> The only data we have is, by definition, standards of practice… Because we've had to have a standardised approach to it [carbon accreditation], we can't just say 'every single scheme we are going to go out individually and judge, based on how, with limited knowledge, what we think is going to happen.' We have to basically take the average and then make it very conservative. So we're almost erring under the lower side of things just to be cautious.

To summarise, calculative conservatism is an epistemic commitment pursued by the WCC's designers from the code's very inception in the late-2000s. Conservatism helps perform both the scheme's legitimacy and the legitimacy of the credits it authorises. In David Lansing's terms, conservatism thus helps "constitute the forest as an object of economic exchange" (2012: 212) in a way that guards against potential controversies, especially as the limits of the natural capital approach to environmental governance become more publicly known.

A trial of legitimacy

Successful and strategic bids for legitimacy do not necessarily last forever. In this section, we introduce the idea of a *trial of legitimacy* to understand how a carbon accreditation scheme's metrics and protocols get scrutinised by the actors whose assent is needed for the long-term functioning of the offset market. In the WCC, this trial gathered around concerns about the protocols the code used to judge *economic additionality*, and the undesired outcomes and unwanted forests created through its finance allocation mechanisms.

To generate carbon credits through the WCC, forests must demonstrate additionality, which means the new woodland captures carbon "over and above that which would have happened anyway" (Woodland Carbon Code, 2019). Forest creation projects must pass two additionality tests: the Investment Test (also known as economic additionality) and the Legal Test (known as legal additionality). To pass the Legal Test, there must not be a legal obligation for a forest to be planted, such as the legal requirement to 'restock' a recently felled forest.

More important for our discussion here is the Investment Test, over which the WCC has more autonomy and for which it is more answerable. The Investment Test is designed to prove that a given forestry project requires carbon finance to be economically viable. In theory, if a project

would be profitable without carbon finance, then it should not pass the economic additionality test. Economic additionality tests ensure that the money which buyers pay for credits is causally deterministic: that without their money, the trees would not have been planted, and the carbon would not have been stored.

Economic additionality is a qualitatively different type of additionality from the dominant ways additionality is accounted for in other carbon markets. Largely, additionality is assessed by measuring net increases in carbon sequestered, saved, or stored ("there is x more carbon sequestered due to this project") but does not necessarily assess if the project would have gone ahead without carbon finance (Purdon, 2015). Measuring additional carbon is a complex and often vague process, which can be fudged to produce 'better' outcomes for specific actors (Gifford, 2020; Lovell and Mackenzie, 2011).

Maintaining successful economic additionality criteria is a crucial element in the WCC's framing of itself as high integrity compared to other carbon markets which are subject to softer assessment criteria and do not necessarily include economic analyses (Valiergue and Ehrenstein, 2022). In interviews, the WCC's higher standards, particularly its economic additionality standards, were routinely appealed to by carbon brokers to differentiate high integrity UK credits (genuine, trustworthy, legitimate) from other voluntary carbon markets, especially REDD+ markets in the Global South, which have faced widespread critique for selling 'phantom credits', which don't have a link to material reality (West et al., 2020). As one carbon broker explained in an interview,

> The vast majority [of carbon buyers] have very keen interest in financial additionality being upheld and scrutinized and tested, despite the fact they acknowledge it's challenging…they expect there are efforts made to try and ascertain whether a project is in need of that carbon funding to enable it to go ahead.

The WCC's economic additionality test is conducted on Excel, using the WCC Cashflow Spreadsheet. In the early 2020s, however, the WCC's Investment Test emerged as a site of contestation in the sector.

In interviews, several carbon brokers explained that the forest carbon market had changed rapidly in the two years running up to COP26, held in Glasgow in November 2021. The lucrative financial opportunities available from UK-based carbon forestry had become clearer. As more companies used the WCC, the technical flaws embedded in the code's spreadsheets used to adjudicate economic additionality were becoming evident. Large-scale commercial forestry organisations, who increasingly have dedicated carbon departments specialising in using the WCC, were finding ways to pass large-scale commercial forestry projects (which derive profit from the timber being produced) through the WCC's economic additionality test, even though they clearly would have been profitable without carbon finance. Using the technical apparatus provided by the WCC (a spreadsheet), these companies could frame their plantations in ways that made them appear unprofitable without carbon finance and thus generate carbon revenue as well as future timber revenue.

Julie, a commercial forester who used to work for one of these forestry companies, explained that many commercial conifer plantations, which were largely producing Sitka spruce (a non-native timber species which dominates Scottish forestry), were passing the Investment Test, even though they "should struggle to get through the WCC because they aren't [economically] additional." She explained how a commercial forestry organisation could input massively variable prices into the WCC Cashflow Spreadsheet, making the cost of the project more likely to appear unprofitable. She gave me an example,

> When I was working at [a large commercial forestry company], they were putting through a Sitka plantation into the WCC… and the landowner would just say, 'what do you want the [input] figures to say?'

> They'll come up with a budget for the 'alternative land use' that will just make it work. And it's only checked once! And the evidence you need to provide is minimal. So unless they check the evidence at that first point, you are validated and you can make as much money as you want!

Julie stressed that calculating the financial costs of 'alternative land use' was beyond the knowledge of a commercial forester. Given the contingency and uncertainty of different land uses and market changes over the next 100 years, *nobody* could calculate this with any degree of genuine accuracy.

She was forced to input data about the potential income from sheep farming, an alternative land use, for a 50-year time horizon – something she knew nothing about. She had to "trust the figures" that a landowner would give her, even though she knew they might change them to "make farming look a lot worse than it actually is". The worse the alternative land use appeared, the lower the financial baseline against which economic additionality could be compared, and the easier it became to prove that the new planting scheme *required* carbon finance to make it profitable. The WCC's economic additionality assessment protocols allowed unscrupulous actors to benefit from a strategically cultivated sense of ignorance and unknowability (Brice et al., 2020). The variable input figures were helpful tools in performing a project's economic non-additionality, producing a 'counterfactual display' that generated legitimacy for the credits produced (Ehrenstein and Muniesa, 2013).

Examples of such data-fudging were commonplace during the fieldwork period. Foresters explained how the price of a land purchase could be included to ensure that the WCC spreadsheet would regard the project as otherwise unprofitable. In this way, purchasing and owning land could be framed as a sunk cost rather than an asset increasing in value - a problematic narrative which has a long history in Scotland (Wightman, 2010). Where scholars have previously identified how the virtuality and ecological unruliness of offset carbon creates opportunities for actors to profit unfairly from warming mitigation measures (Bracking, 2015; Lippert, 2015), here it is the unverifiability of factors like land price and profit projections that represents an opportunity for manipulation. Additionality was being gamed by reflexive and strategic baseline (Barandiarán, 2020; Purdon, 2015) and counterfactual (Lohmann, 2005) quantifications. The economic additionality criteria, which were introduced to bring legitimacy to the WCC compared to other accreditation schemes, were allowing a problematically wide range of projects to receive carbon finance.

Over the course of the fieldwork, this flaw became a widely known problem, including by those developing and maintaining the WCC. Nick, who worked for the WCC, provided an example of a forest which was passing the economic additionality test, even though it clearly shouldn't: a forest composed of "83% net planted Sitka spruce … on good land and full grant support". This was *clearly* an already profit-turning project; it was growing commercial and harvestable timber (Sitka spruce), on good land (the trees would grow well, and the harvesting would not be too strenuous) and had already received grant support (the forest's planting and fencing would be partly funded by Scottish Forestry, the state forestry department). The fact that forests such as this could be framed as 'non-additional' by the WCC's *own* apparatus, and subsequently be accredited with carbon credits, was dangerous for the legitimacy of the WCC and the entire woodland carbon market. Such visible failings demanded action and new forms of accreditation to maintain the legitimacy of the code. By late 2022, there was keen interest to tighten the additionality criteria from actors across the forestry sector.

Tightening additionality

Aware of the loopholes within the WCC, and following a long consultation organised by the Forestry Commission between businesses and independent reporters, the managers of the WCC tightened the economic additionality criteria in October 2022. Pat Snowden, the Head of

Economics and the Woodland Carbon Code for Scottish Forestry, described the motivation behind this shift in a press release:

> Carbon credit schemes have significantly increased over the past few years… During this time, we've seen growing interest from a wider range of forestry projects. We welcome this interest and want to grasp the opportunities that such projects bring, including in commercial forestry, but have found that in some cases projects are testing the limits of how eligibility rules for the WCC currently operate. It was clear that we needed to review the rules of the Code so that it remains credible in the carbon market. (Scottish Forestry, 2022).

And Snowden described the changes made:

> We've standardised the tests so that they are applied more consistently… and very importantly, we've made changes so that high up-front land values don't skew the calculations associated with the additionality test. We've replaced the purchase price of the land with published data on income foregone as a measure of the value of land. Our analysis shows that this results in more sensible and credible outcomes from applying the test. (Scottish Forestry, 2022)

Under these new rules, instead of a forester inputting what they expected different elements of a project to cost (such as the costs of fencing or tree planting), standardised figures automatically populate the spreadsheet depending on the project's species mix, location, and size. One carbon broker explained that as a result "there is far less opportunity to game your project and its budget and the incomes… there's going to be pre-set costs and incomes hardwired into the additionality calculator". Inflated land prices, which forestry companies were happy to pay because the increased cost would be used in their economic additionality figures, could also no longer be inputted to frame a project as unprofitable. Such interventions were designed to patch up the legitimacy of the metrics and protocols used by the WCC.

Whilst the changes made to the additionality tests were primarily in response to the local and sectoral controversies, other larger forces were subjecting the WCC and the forests it was helping finance to higher degrees of scrutiny. Nick, the representative of the WCC, explained that during the trial of legitimacy,

> The credibility of the code was at risk. And there are task forces out there that are looking at the integrity of these different codes internationally. And they're doing thorough reviews of every aspect of your permanence, your measurability, your verification process, your governance, your additionality. And so, if it can be proved that your additionality isn't up to scratch, then your code will become worthless.

One of the taskforces being alluded to here is the Taskforce on Scaling the Voluntary Carbon Market (TSVCM), which was created in response to the growing list of failed or flawed environmental offsetting projects and the need to ensure that voluntary carbon markets are high integrity. It is a private sector initiative designed to ensure that the "market can deliver to the needs of its participants without compromising the integrity of decarbonization" (TSVCM, 2021: 5). Individual accreditation operators, like those involved in the WCC, as well as several foresters and carbon brokers who routinely use the WCC to accredit their projects, were mindful of the additional scrutiny being placed on their markets by such taskforces. They shared a fear about the impact local scheme failings were having on the trust projected onto market-based mechanisms on a more general level. This atmosphere of mistrust was particularly pronounced in the months following this research's fieldwork period, as widespread media attention highlighted the illegitimacy of many forest carbon offsets worldwide. The Guardian, for example, ran an investigation which

found that more than 90% of rainforest carbon offsets certified by Verra, the world's biggest offset certifier, did not correlate to genuine carbon reductions (Greenfield, 2023). The credits were worthless and had been used to offset emissions elsewhere, certainly contributing to increased net carbon in the atmosphere and the deterrence of more radical mitigation measures (Markusson et al., 2018).

Legitimacy is, from this perspective, an achievement that emerges not just from a set of local ecological outcomes and from the assent of participating actors (carbon traders, land managers, foresters, carbon offset buyers, etc.). It is also something conditioned by the macro-level political and economic context within which it operates, and the actions which accreditation scheme designers and users take in response. Bids for legitimacy authored by individual accreditation scheme operators thus interact with forces that far exceed their local sites of action.

There is an interesting dynamic here about the interactive relationship between local-global concerns around natural capital market legitimacy. In the case of the WCC, global anxieties emanating from the ambivalent outcomes of the global carbon market successes are conditioning how accreditation scheme operators act to maintain the legitimacy of their specific offset market. As other scholars writing in this space have noted, however, localised actions (like the tweaks made to the WCC additionality criteria) ripple upwards and outwards, too. In Blum's (2020) analysis of UNFCCC debates on climate mitigation strategies, the existential threat that might otherwise be posed by the patchy successes of offset markets is, from the perspective of policy makers and other delegates working at the international scale, displaced by a belief that voluntary carbon markets are being better and better regulated and that their social, political, and ecological outcomes are improving. The responsive actions of those operating individual schemes like the WCC accumulate to legitimate not only their market but the wider natural capital approach to governing the environment.

The fact that natural capital markets are always piecemeal, subject to dispute, gameable, challengeable, flawed, and so on, has been a locus of critique from scholars, activists, and other sceptics (Cooper, 2015). But in the example laid out here, the need to constantly tinker with carbon offsetting's sociotechnical apparatus to maintain its legitimacy is not framed as a *limit* of natural capital markets. Rather, the tinkering is a performative act in itself, which reassures all parties that legitimacy is continually being strived towards. It is part of the ongoing investment of epistemic work needed to keep the scheme alive in the face of the inevitable scrutiny (Christiansen, 2024). Legitimacy, here, is a shared achievement that is always in the making.

Although such dynamics far exceed the purview of individual scheme operators, they do imbue their laudable intentions – to improve how their schemes allocate finance and create specific natures – with a more complex political valence. Conflating relative improvements (e.g., that the WCC is getting 'better' by fixing bugs in its finance allocation process) with absolute quality risks contributing to a form of climate delay (Carton, 2019; Carton et al., 2023) whereby tweaks to the accreditation process are taken to be evidence of its overall political desirability, irrespective of the ambivalent outcomes it might be producing in the meantime. The action-reaction - or concerned-civilised (Valiergue and Ehrenstein, 2022) - cycle in offset market design is an important means through which carbon-based economies continue to block pathways to lower-carbon futures (Lohmann, 2010). This might be read as an environmental manifestation of what Andrew Barry describes as the 'anti-political economy' (Barry, 2002), in which the increasing importance of measurement and information in contemporary governance ensures that certain activities which *could* be understood as political are delegated to experts and framed as non-political issues. As debates continue about how carbon offsetting markets can be designed and improved, with questions centring around which technical apparatus, measurement techniques, and legal definitions to use, political questions about whether climate change and biodiversity loss *should* be delegated to offsetting mechanisms are overlooked. This can be considered a depoliticising move as it overwhelmingly concentrates contestation about natural capital markets to actors with a vested interest in maintaining their existence, rather than opening a more public and democratically engaged line

of critique about whether nature and climate issues should be delegated to markets at all (Markusson et al., 2018).

Of course, from the perspective of those operating the WCC to ensure the long-term legitimacy of its credits, these global tensions were less immediately concerning than potential sectoral fallout following from the economic additionality updates. There was, in particular, a worry expressed by interviewees working with the WCC that the changes made to the additionality tests would be interpreted as a partisan move against commercial (non-native conifer) plantation managers. This is because native broadleaf projects, unlike commercial plantations, are not generally sold as timber, meaning that they can more easily pass the newly stringent additionality tests.

One carbon broker explained the ecological consequences of the economic additionality update in October 2022:

> Clearly attention is going to be more focused towards native broadleaf planting… Basically it means I think that pretty well all new native woods will pass the [economic] additionality rules, but quite a lot of the productive [commercial timber] Spruce woods – depending on the previous land use – will not pass the additionality test.

As a result, many carbon brokers interviewed in the run-up to the Investment Test update in October 2022 expected to create more WCC-accreditable native woodlands following the update, especially as the price of carbon credits generated from native woodlands could warrant a 'boutique' or 'charismatic' premium compared to offsets generated from commercial plantations (Valiergue and Ehrenstein, 2022), as they promised ecological gain alongside carbon sequestration.

Diversifying the range of species being planted and accredited holds clear value for the WCC's image, as there is growing public interest in nature restoration, especially in Scotland (Stanley et al., 2025). Increasing the amount of native woodland created by the WCC - achieved through tweaks to its additionality protocols - allows the WCC to be framed as a mechanism supportive of nature restoration. Again, the perceived legitimacy of the WCC turns on its ability to mediate between the political and economic pressures manifest in the demand for a functioning carbon market, and the ecological outcomes the code's design creates.

Accreditation schemes like the WCC hold together diverse actors, diverse interests, and diverse business models (Koronka et al., 2022). Legitimacy emerges when all of that diversity is sufficiently well accommodated. This, by and large, occurs when everyone broadly agrees on the metrics, rules, and regulations being observed, and when the social and ecological outcomes of a scheme are acceptable in a particular political atmosphere (Lansing, 2011). The important insight here is that the long-term functioning of natural capital markets is achieved through reflexive and strategic bids for legitimacy that are undertaken by accreditation scheme operators. These bids are designed with respect to the needs and desires of the actors the scheme holds together, the un/desirable socio-ecological outcomes the scheme is creating, and the wider political-economic regimes in which they operate.

Conclusion: streamlining natures and restoring ancient woodland

Over the course of the paper, we have seen how ecological, political, and scientific forces converge in the UK voluntary carbon market, and how that convergence can threaten to destabilise the functioning of the market by undermining the legitimacy of the credits that are traded on it. We have also seen the reflexive and strategic moves accreditation scheme operators make in response. Legitimacy is, for these actors, something their accreditation scheme achieves through ongoing work, and something that emanates outwards from it. These interventions, much like the choice regarding which metrics and measurement technologies should be used by the WCC to verify carbon

credits (Stanley, 2024), are reflexive, strategic, and iterative (Lansing, 2012; Lippert, 2015). Legitimacy is hard fought and hard earned, and actors variously draw on the epistemic appeal of objectivity, quantification, conservatism, and political neutrality to secure it.

Trials of legitimacy to natural capital offset markets are inevitable. As unexpected ecologies materialise, and as the political and economic context changes, new issues must be ironed out. These represent new *trials of legitimacy* that might have nothing to do with whatever came before. To conclude this article, we want to speculate on this direction of travel by highlighting an emerging threat to the WCC's legitimacy which results from the growing political appetite for nature restoration in Scotland.

As part of the Scottish Government's interest in scaling up nature restoration through natural capital markets, a new discourse has emerged from a set of environmentalist and social justice organisations. Sceptics query whether natural capital markets can successfully deliver the ecological goals of restoring rare and underfunded habitats (Stanley et al., 2025). These concerns feed into a broader desire – one introduced at the very start of the article – to ensure the UK's natural capital markets are high integrity and qualitatively distinct from natural capital markets in other regions that have been plagued with controversies. Against this backdrop, there is a concern that the WCC has struggled to finance the restoration of ancient woodland, a celebrated form of conservation that has long faced financial barriers (Robbins and Fraser, 2003; Sharma et al., 2023). For many rewilding ecologists we interviewed, restoring these often fragmented and over-browsed ancient woodlands by allowing them to grow from existing seed sources was seen as the "holy grail" of forest creation. This process, known as natural regeneration, allows endemic ecological communities to expand outwards and requires less soil disturbance than planting techniques (Lewis et al., 2019). In Scotland, this is best achieved by limiting herbivores' capacities to eat saplings by culling deer and erecting fencing (Rewilding Britain, 2020).

Yet the natural regeneration of ancient woodland cannot easily pass through the WCC and its assessment criteria. In legal terms, native ancient woodlands in poor ecological health, which would greatly benefit from new financial mechanism to finance their protection and restoration, already *exist*, making it difficult to prove that interventions are creating additional *new* forests. This means they struggle to pass the Legal Additionality Test. Furthermore, the WCC's underlying calculative conservatism and standardisation do not neatly accommodate the indeterminate and uncertain growth patterns — properties that ecologists celebrate in rewilding ecology (Lorimer and Driessen, 2014) — of naturally regenerating woodland. As nature restoration continues to be delegated out to offsetting markets, certain management practices struggle to adapt to the commodification process (Markusson, 2022). Markets require streamlined temporalities and investors want predictable returns. As a result, the ecological dynamics that are unpredictable or difficult to measure in a standardised way, and which exceed the limits of spreadsheet-based reporting mechanisms, fail to materialise (Robertson, 2006).

The tendency for natural capital markets to produce streamlined natures which deliver measurable and maximisable financial returns — the process we have elsewhere described as markets' 'environment-making performativity' (Cusworth and Stanley, 2025) – has been well documented in over two decades of critical social science research. Recently, though, the failures of the WCC to deliver a wide range of ecological projects have also become a matter of public concern. In 2023 and 2024, nature restoration organisations were frustrated that restoring remnant ancient woodlands could not receive funding from the WCC. In April 2024, changes were made to the WCC to enable the natural regeneration of ancient woodlands to more easily pass through the WCC's accreditation process. Ancient woodlands with a canopy cover of less than 20% could legally count as 'not-forest' and therefore their restoration through natural regeneration could be considered forest creation (Zulu Ecosystems, 2024). Through this change in legal

definition, an under-funded habitat type became 'legible' to the market (Scott, 1998), as it could be accredited by the WCC.

These amendments to the WCC were the product of close collaboration between different actors in Scotland's forest governance space, including private companies, rewilding NGOs, and state departments. As with the analysis offered in the main three empirical sections, ecological, scientific, and political forces interacted in a way that exerted pressure on the accreditation schemes. Here, the *lack* of WCC-backed ancient woodland regeneration projects (owing to their functional illegibility due to the code's technical and legal regulations and measurement protocols) rubbed up against growing public interest in nature restoration in a way that potentially threatened the legitimacy of the code. The legitimacy of the WCC was being subtly undermined, owing to the way the code itself was excluding a set of conservation practices that were benefitting from an uptick of public and scientific enthusiasm.

As the performative relations linking the WCC's metrics and protocols to Scottish ecologies forge on, and as the broader political context in which those materialisations take place continues to change, natural capital market operators must constantly respond to new trials of legitimacy. These trials require stakeholders to not just reiterate the link between a virtual credit and its material counterpart, as has been the case in other empirical studies (Gifford, 2020; Lansing 2012), but to change the system that allows those representations to be bought and sold on offset markets in the first place.

There is a key insight here. Whilst we generally agree with the political ecology writing in this area – that "it is much harder and more work is involved in assessing the [carbon] removal effect of a heterogeneous, biologically diverse site that has been allowed to re-wild, than of a homogeneous, engineered tree plantation" (Markusson, 2022: 3) – this stance risks reaching an overly static and technologically-deterministic conclusion. Accreditation schemes choreograph the way that ecologies are translated and commodified into carbon credits. As we have argued in this paper, this choreography responds to the way in which legitimacy is (un)made through the continual interactions of political, ecological, and representational processes. Contrary to the way the issue has been framed by others working in this area, the illegibility of certain ecosystems (i.e., messy, heterogeneous, rewilded ones) to natural capital regimes is not a feature that is *inherent* to them. (Il)legibility emerges as a function of the political and cultural atmosphere in which relevant actors deploy certain metrics and protocols to represent the world in specific ways. As the conditions for legitimacy move on, so too must the legibility of different natures.

For its supporters, the willingness of those in the WCC to change its legal and measurement systems to make different natures legible and investable is central to the sustained legitimacy the UK natural capital market. There is, though, a more ambivalent political interpretation on offer. In this more critical reading, the responses made to successive trials of legitimacy function as part of a wider symbolic politics that obscures some of the more problematic outcomes of market-based solutions to environmental crises. Updates and tweaks can be a performative display, appealed to as evidence of the reflexivity and care with which natural capital schemes are being redesigned in response to new scientific and public expectations, even as those markets continue to sustain a problematic status quo approach to environmental governance. Recognising and responding to trials of legitimacy, even when undertaken by scheme operators with the best intentions, are part and parcel of the way natural capital markets continue to block pathways to lower-emission futures (Lohmann, 2010). It is a paradigmatic example of *mitigation deterrence,* as publics, politicians, and sceptics are convinced of the success of natural capital approaches in delivering carbon sequestration and nature restoration, whilst more ambitious attempts to mitigate emissions or end ecologically degrading practices, such as sterner financial reforms and tighter environmental regulations, are overlooked (Markusson et al.,

2018). This, we maintain, obscures the limitations of natural capital approaches to environmental governance, and the inherent paradox of selling nature to save it.

Highlights

- This paper explores how the Woodland Carbon Code (WCC) maintains its legitimacy over time.
- Finance allocation, additionality criteria, and carbon measurement systems create legitimacy for natural capital codes, credits, and markets.
- Ecological, political, and scientific forces interact in ways that threaten the legitimacy of natural capital markets.
- Accreditation schemes reflexively respond to reputational risks by changing how they measure nature, allocate credits, and channel finance.
- The (il)legibility of nature is an emergent effect of accreditation systems rather than an inherent property of ecosystems themselves.

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