



Leverhulme Centre
for Nature Recovery



ICCS
Interdisciplinary Centre for
Conservation Science



UNIVERSITY OF
OXFORD

High-integrity nature markets

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- How can we get investors to invest more in conservation?
- How can we get more good projects?
- How can we get fewer bad projects?
- The stories at the interface of **nature and money**

Making nature markets work

- **Introduction to nature finance / nature markets in context**
- Tour of nature markets
- What have we learned about integrity

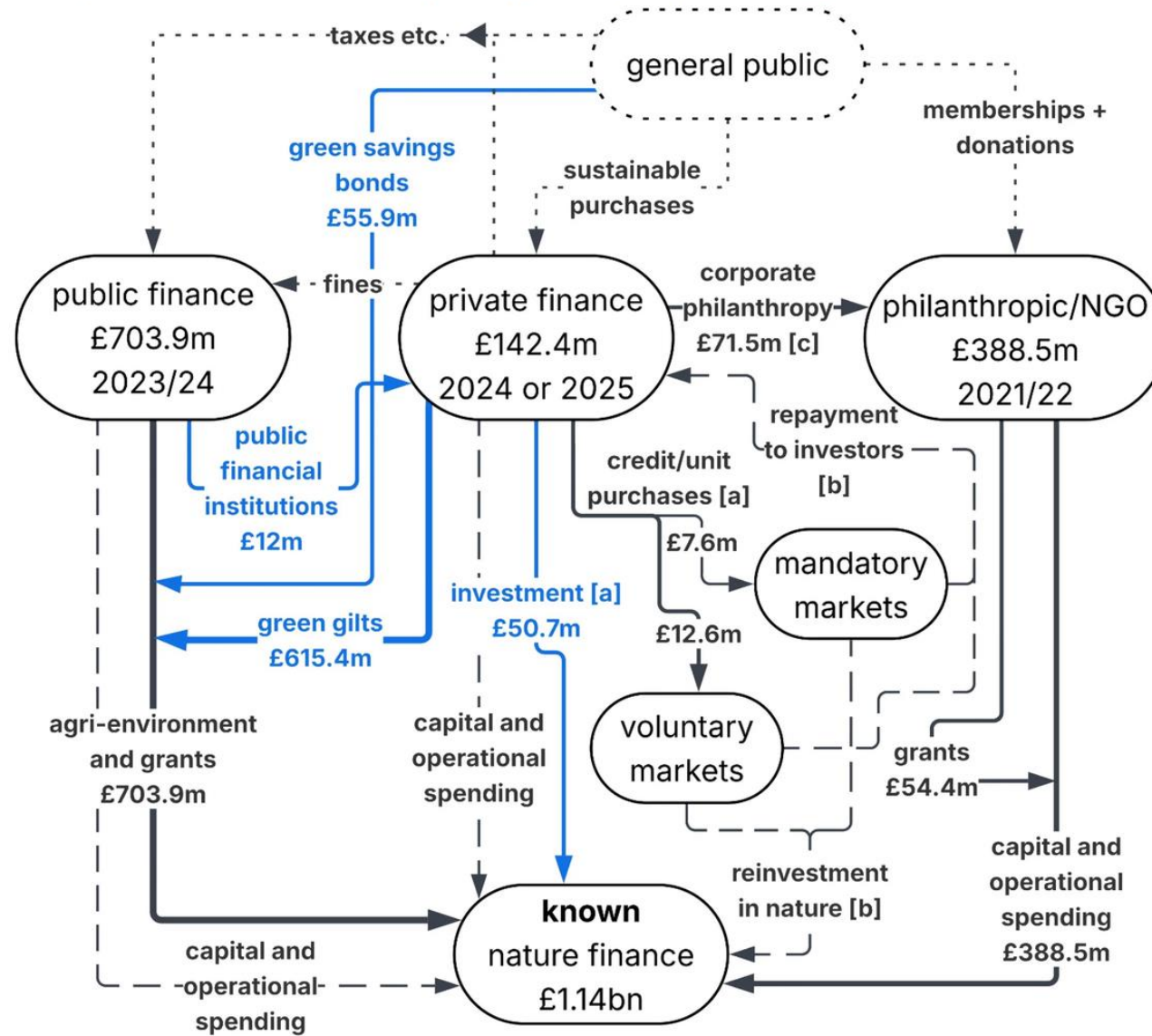
Important high-level policies

- Kunming-Montreal agreement – Target 19
- TNFD: “Amount of capital expenditure, financing or investment deployed towards nature-related opportunities, by type of opportunity, with reference to a government or regulator green investment taxonomy or third-party industry or NGO taxonomy, where relevant... Increase and proportion of revenue from products and services producing demonstrable positive impacts on nature with a description of impacts”
- EU biodiversity strategy, Nature Restoration Law, Carbon Farming Regulation, CSRD, Nature Credits Roadmap
- England: Nature markets framework, BNG

The UK's biodiversity finance landscape

Fig. 1

From: Generating a national snapshot of all publicly reported investments in ecosystem and species conservation across public, private, and philanthropic finance



What is nature finance?

- For conservationists nature finance means **financing conservation**
- For bankers it means projects that relate to land management which deliver commercial returns (mostly agriculture, forestry, occasionally ‘biodiversity substitutes’ like meat replacements)
- For macroeconomists it means the material, financial risks posed to businesses or the macroeconomy from nature loss.

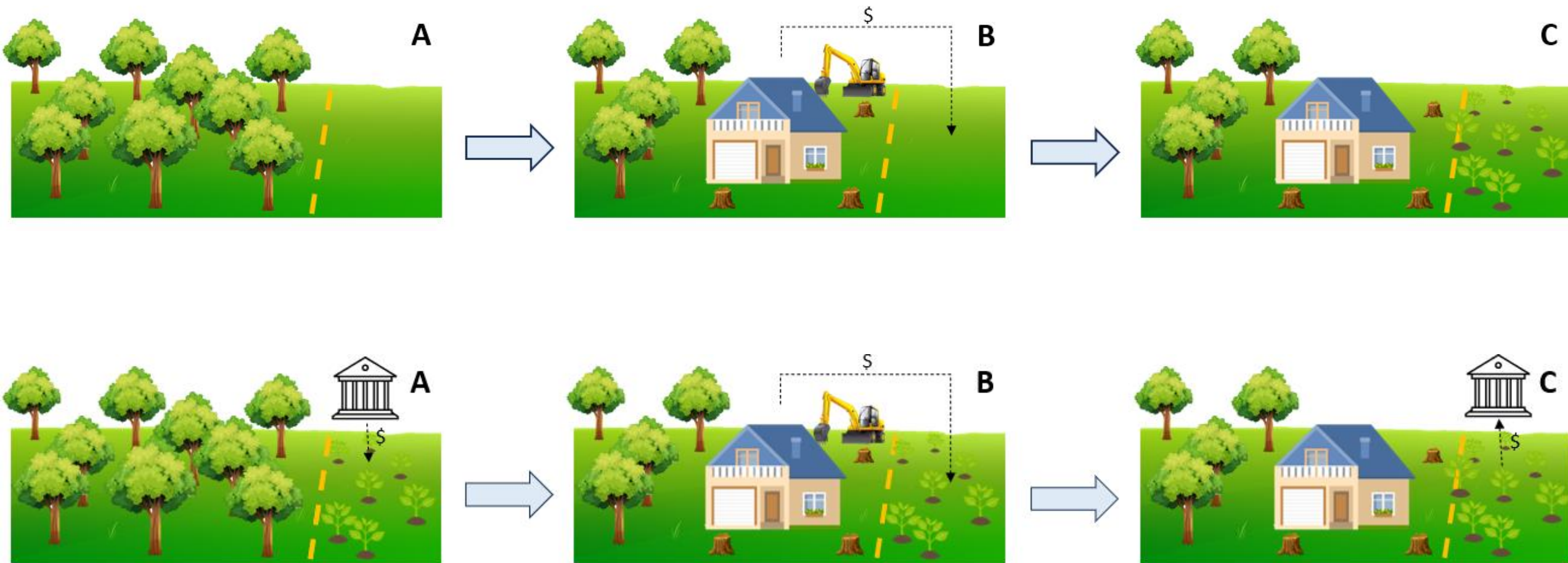
Business models for biodiversity

Business model	Examples	Payment tied to biodv improvement?
Biodiversity co-benefits to ordinary market goods	Ecotourism Certified Commodity Production	No; sometimes for ecotourism
Direct improvements in biodiversity through commodification	Nature markets	Yes; biodiversity benefits of carbon markets are normally captured through standards, not explicit commodification
Nature tech	High-resolution biodiversity monitoring companies	Not in most cases, mostly the data is valuable for optimization or decision-making
Biodiversity enhancing technologies and substitutes	Meat replacements	No, a biproduct of producing a substitute for a biodiversity damaging process.
Enhancing the value of adjacent assets	Urban green infrastructure	No

Making nature markets work

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Nature markets in practice



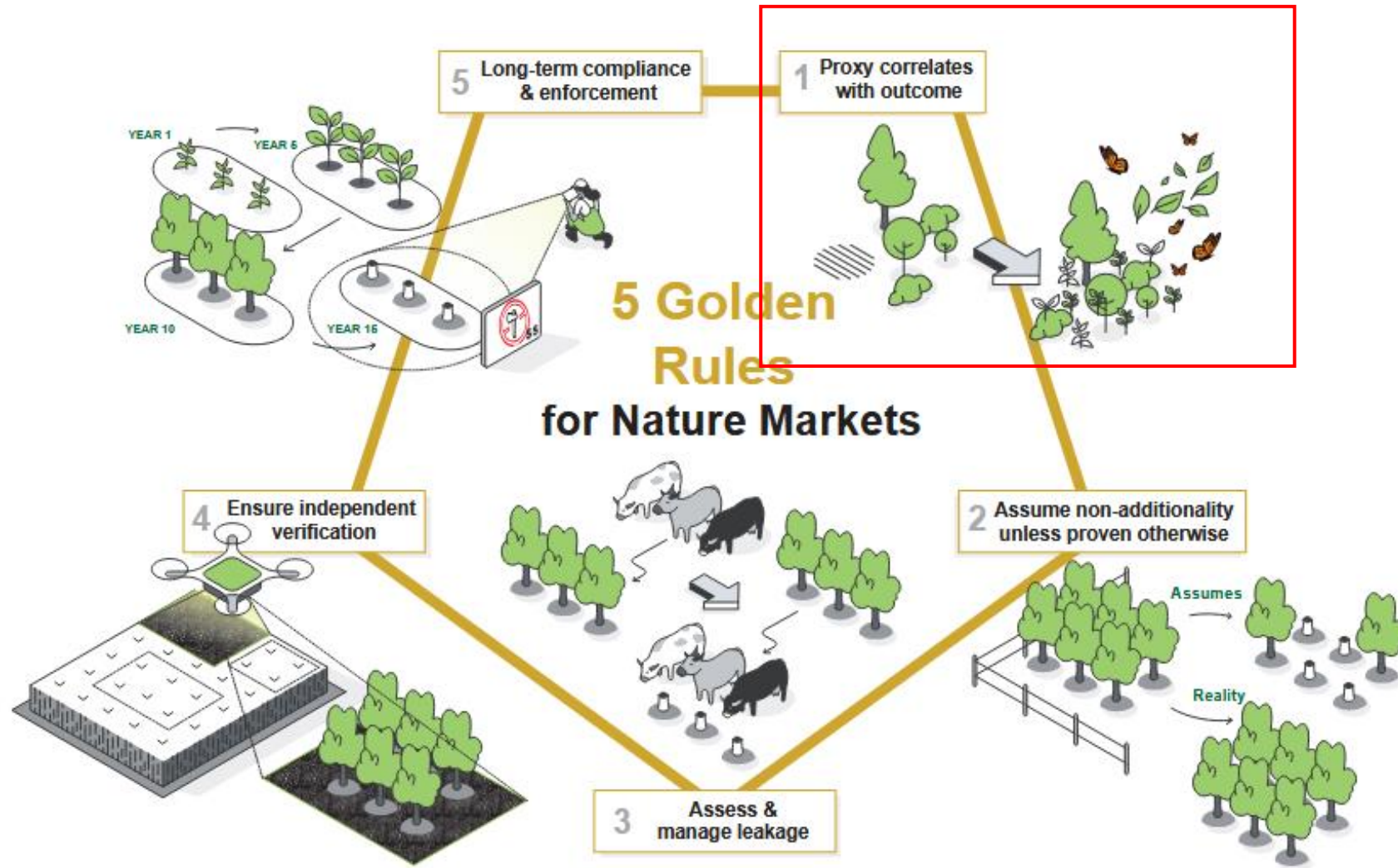
Nature markets around the world

	Who buys them?	Who sells them?	Why?	How's it measured?	How does it deal with additionality?	Who checks everything is going to plan?
US wetland mitigation	Developers	Mitigation banks*	They have to	Area of wetland and performance standards	Implicit	US Army corps of engineers
Victorian native vegetation	Land clearers	Landholders; brokers	They have to	Habitat hectares plus projections of change	Implicit	State government
International voluntary avoided deforestation	Companies	Project proponents; brokers	Voluntary	Varies	Varies	Voluntary non-state governance
International voluntary biodiversity	Nobody yet	Project proponents; brokers	Voluntary	Varies	Varies	Voluntary non-state governance
England BNG	Developers	Developer-led, Habitat banks	They have to	Statutory biodiversity metric	Implicit	Local authority; responsible bodies

Making nature markets work

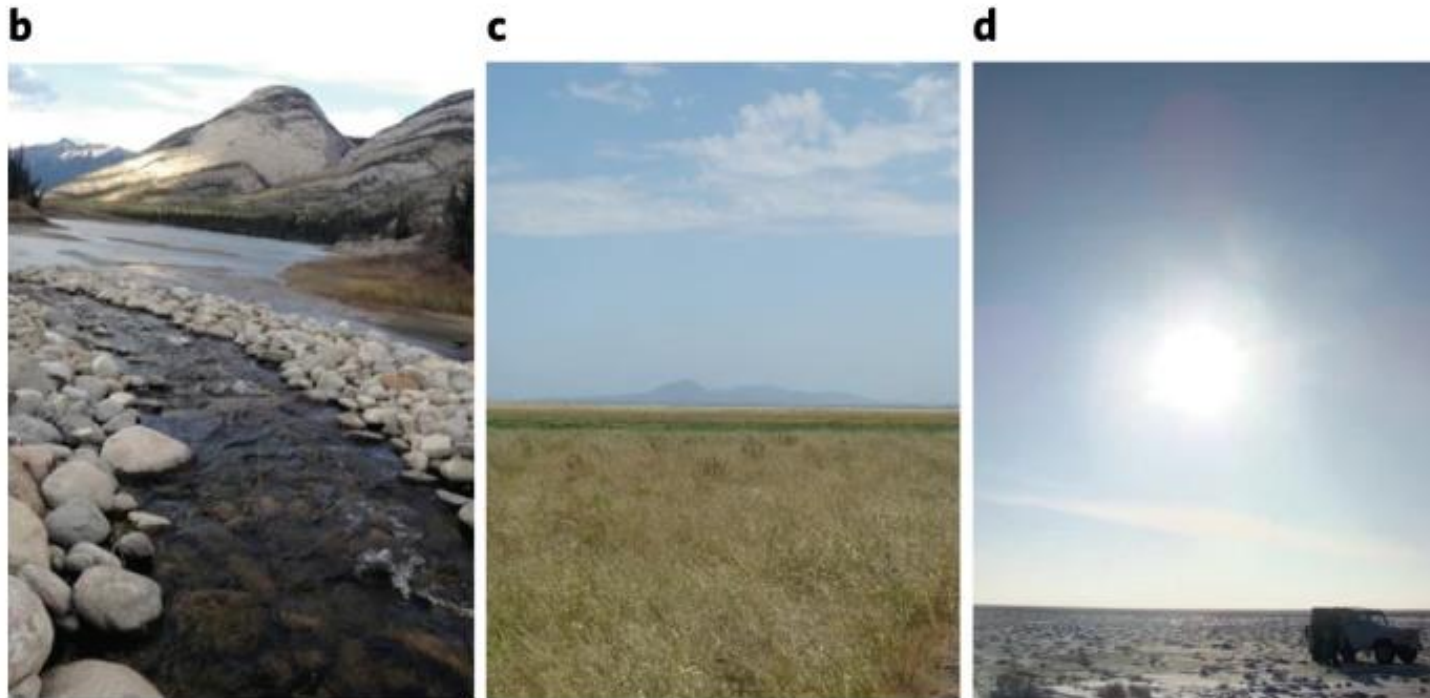
- Introduction to nature finance / nature markets in context
- Tour of nature markets
- **What have we learned about integrity**

5 rules for nature markets: 1) measurement

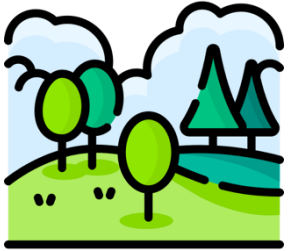


How's it measured?

You can create a market out of anything:



How's it measured?



Baseline Biodiversity Units

= Size * Distinctiveness * Condition * Strategic Significance

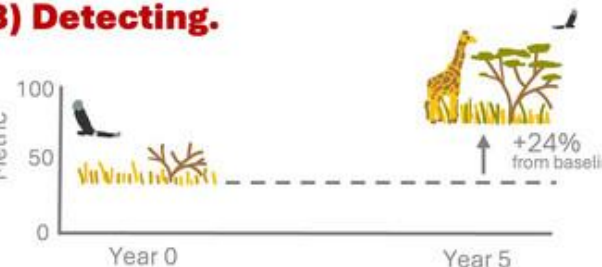
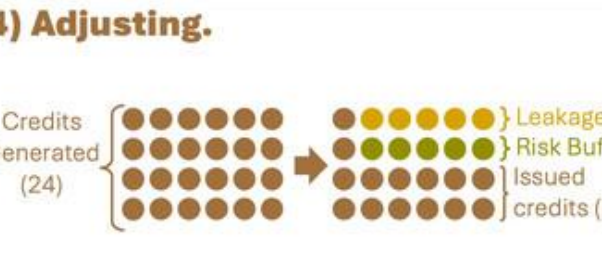


Post-intervention Biodiversity Units

= Size * Distinctiveness * Condition * Strategic Significance

* Difficulty, Temporal, and Spatial Multipliers

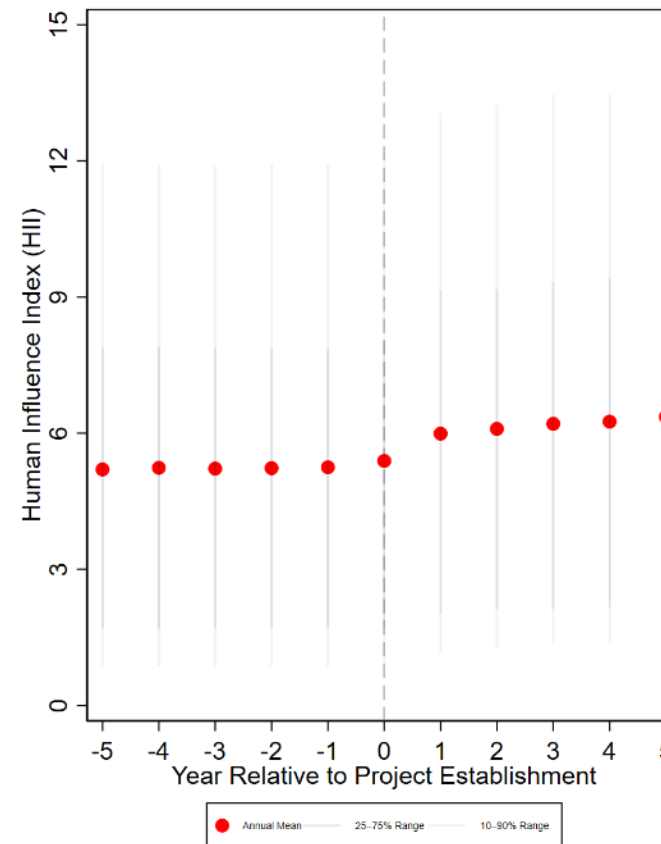
How's it measured – biodiversity credits

a) Stages	b) Key Question & Worked Example	c) Challenges
1) Framing. 	What does one credit represent? E.g. One credit represents one hectare of savannah which has been restored over 5 years	Fungibility: Biodiversity's value is inherently place-based and not fungible at the global scale; treating it as fungible brings ethical and ecological risks
2) Quantifying.  Species Richness = 64 Giraffe abundance = 26 Woody Cover = 37 Average = 42	What metric is used to measure the biodiversity at each time point? E.g. The savannah is quantified via a basket of metrics: a composite metric that takes the average of several normalized sub-metrics.	Representing Biodiversity: Biodiversity is valuable for many reasons, which cannot be fully captured by metrics. Combining Metrics: Bringing multiple metrics into one assumes their values can be directly traded off, and requires difficult choices around normalisation.
3) Detecting. 	How is conservation/restoration detected and attributed to the investment? E.g. The savannah is measured before project intervention begins, and this represents the baseline. In each issuance period, it is measured again, and one credit is issued for every one increment increase from baseline, per hectare.	Commodifying Noise: It is difficult to separate directional change from measurement error or random noise in ecological systems. Additionality: It is difficult to show that conservation or restoration was caused by the investment and would not have occurred without it.
4) Adjusting.  Credits Generated (24) → Leakage (8) + Risk Buffer (8) = Issued credits (16)	How are the number of credits issued adjusted to account for aspects outside of project control? E.g. 20% of credits are held back to account for estimated leakage, and 10% to buffer against uncertainties or unexpected loss. Projects must last for at least 20 years.	Leakage: It is difficult to show that investment has truly reduced, rather than simply displaced, threats. Buffer: Buffers may not be sufficiently large to encompass uncertainties. Permanence: It can be difficult to know how long outcomes from an investment will persist.

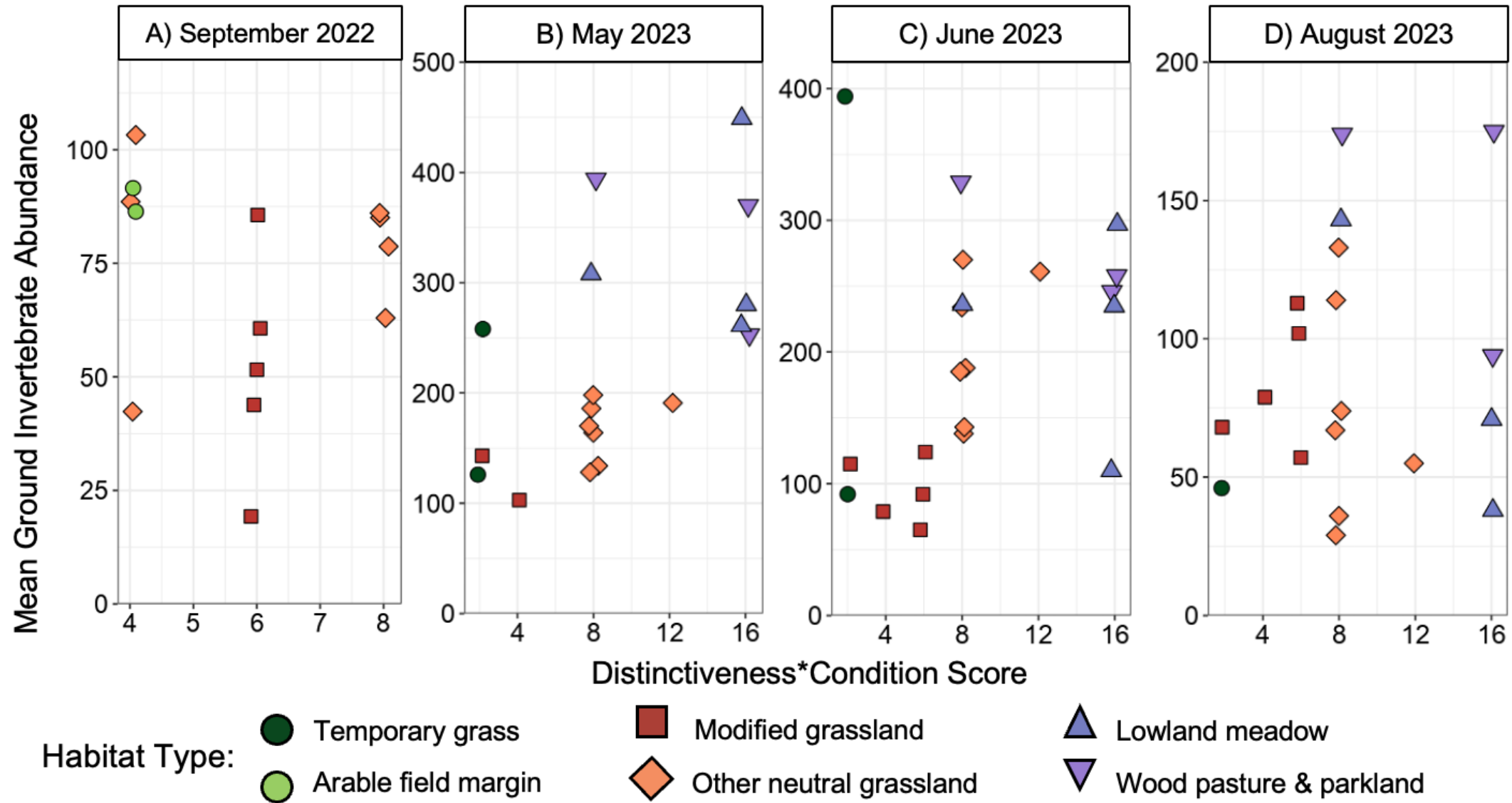
When the proxy has unintended consequences

Figure 4. Biodiversity Impact of Carbon Offsetting Projects.

This figure presents the unadjusted relationship between carbon offset projects and biodiversity, measured using the Human Influence Index (HII), for the full sample of projects over the period 2000–2020. Estimates are based on a balanced panel spanning five years before and after project establishment (i.e., $t - 5$ to $t + 5$). The x-axis shows years relative to establishment, and the y-axis shows mean HII values (higher values indicate greater human impact). Red markers denote average annual HII; filled circles represent observations where the conditioning status equals 1, and crosses represent those where conditioning status equals 0. Shaded areas represent the 25–75% (dark) and 10–90% (light) percentile ranges. The vertical dashed line at $t = 0$ marks project establishment. The joint F-test of the null hypothesis that all pre-treatment coefficients are equal to zero yields $p = 0.999$. A linear OLS fit over the pre-treatment period estimates a slope of 0.009 ($p = 0.132$).



When the proxy doesn't capture the construct

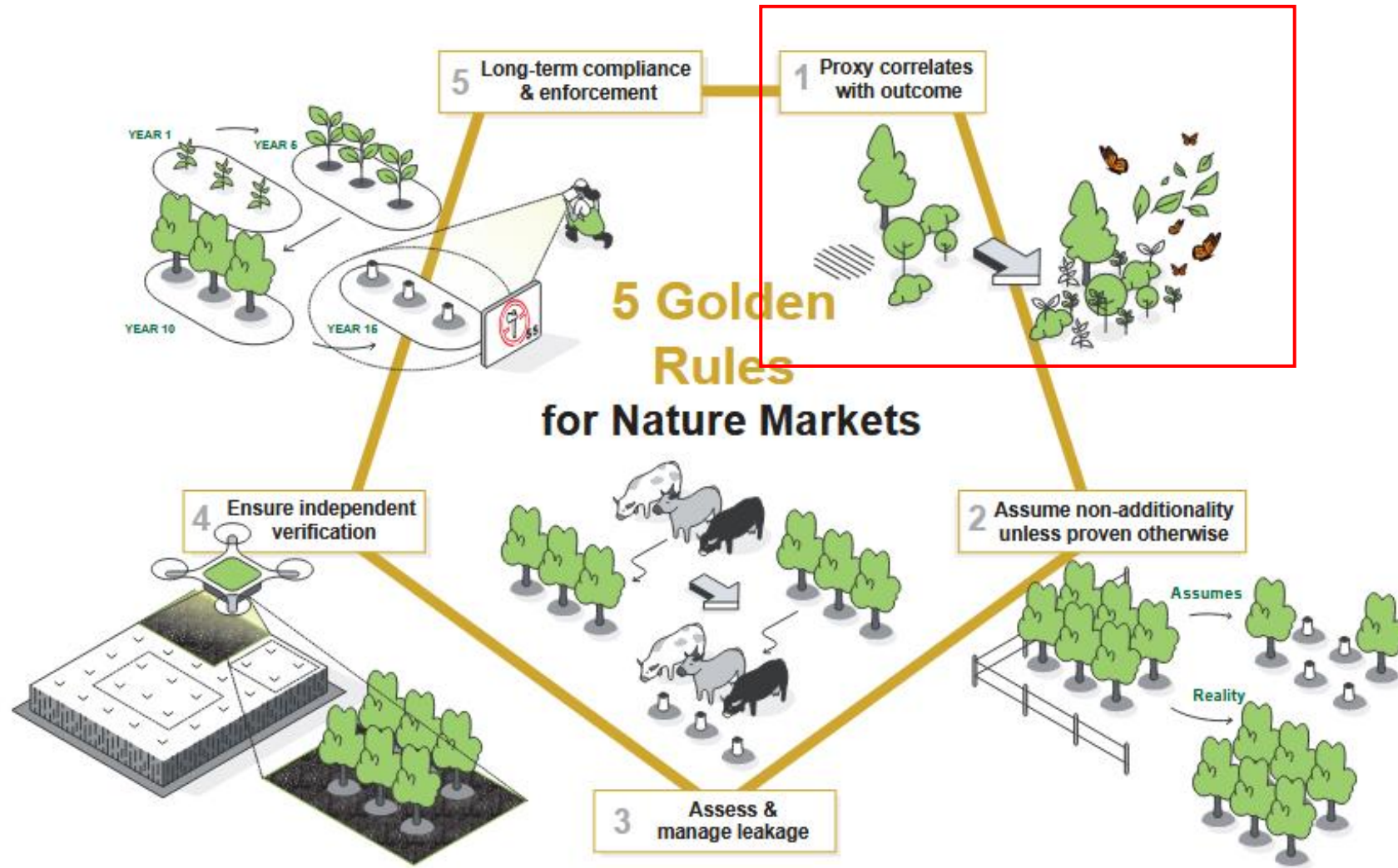


Why are our metrics so simple?

Tensions between **ease of use and realism**

Biodiversity markets are **almost never** trying to optimise for biodiversity, other **competing political objectives** (take BNG)

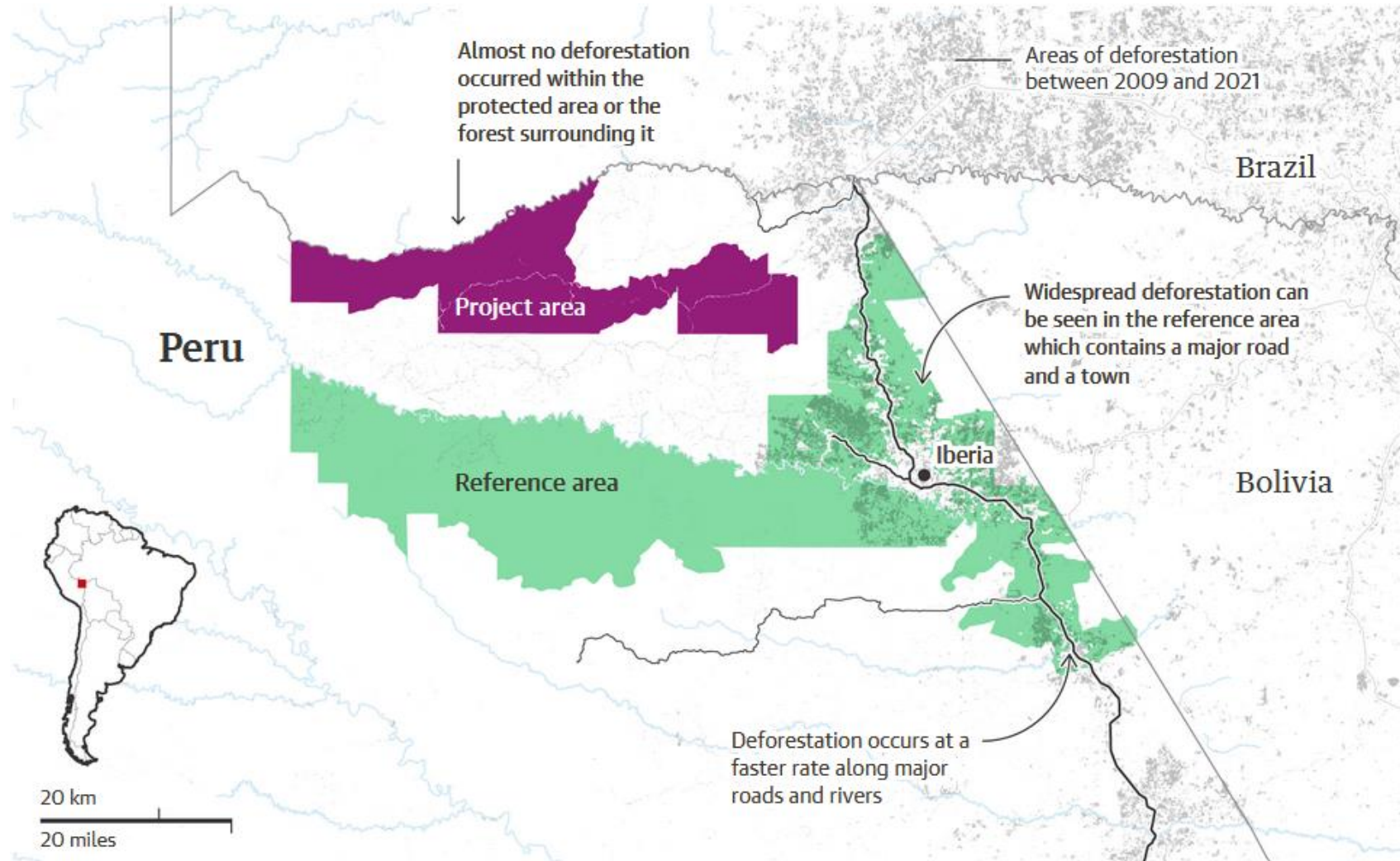
5 rules for nature markets: 2) additionality



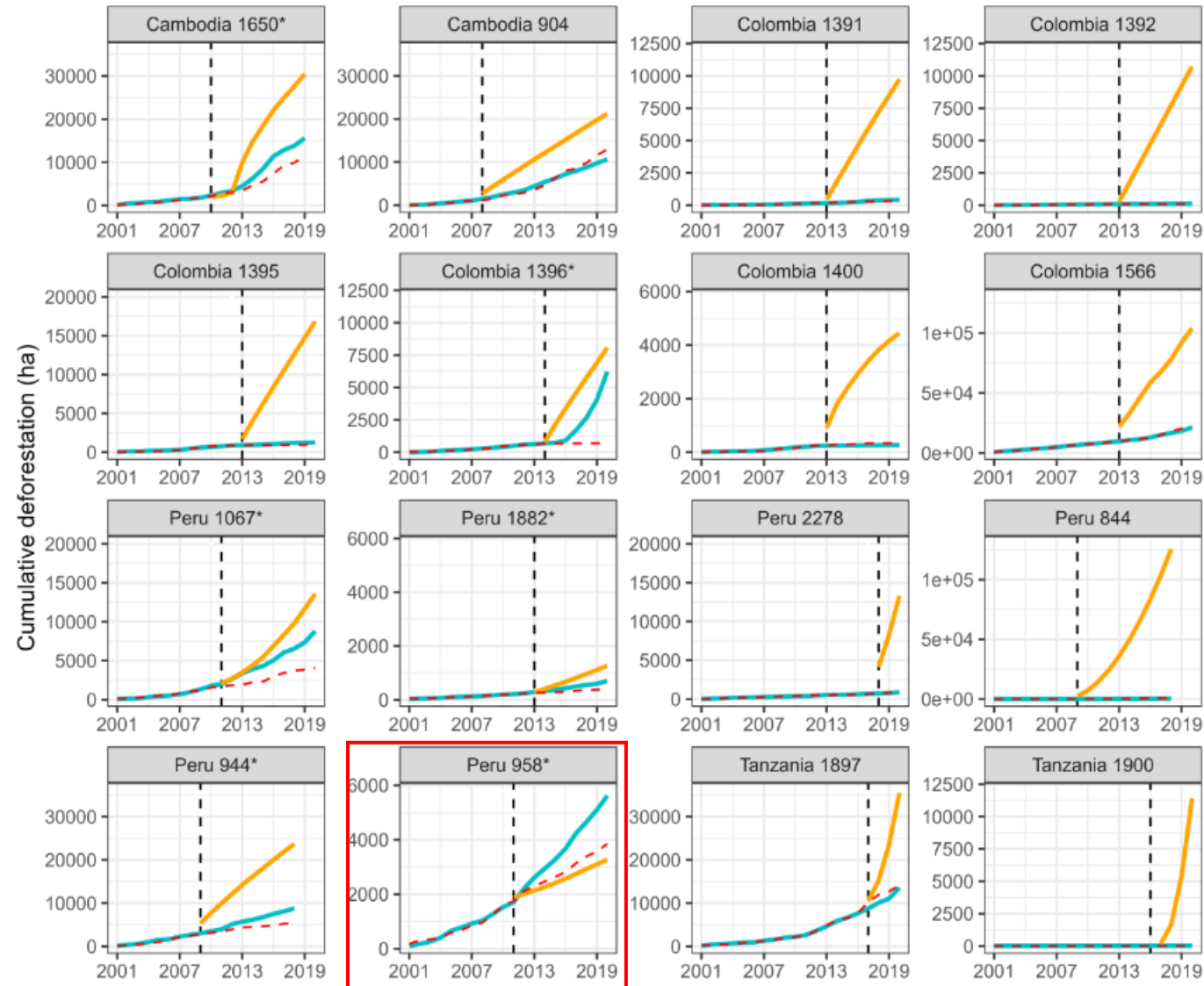
How does it deal with additionality?

- When you're buying the compensation of a loss, **it's really important that thing** is real or the loss is in reality uncompensated
- People opt into nature markets if their opportunity costs are low
- So in a market where sellers opt in to selling, and the action they're selling does not come with an obvious signal demonstrating they've done the thing, **you're selecting for those who would have done that thing anyway**
- ex-post evaluations have detected widespread non-additionality – except Inkinen et al. 2022 (US wetland mitigation banking)

Scientific controversies: additionality



Scientific controversies: additionality

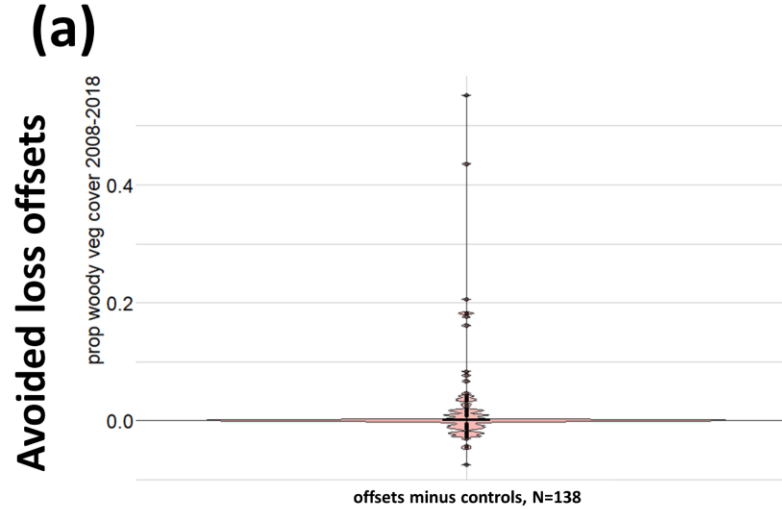


Red: observed
deforestation

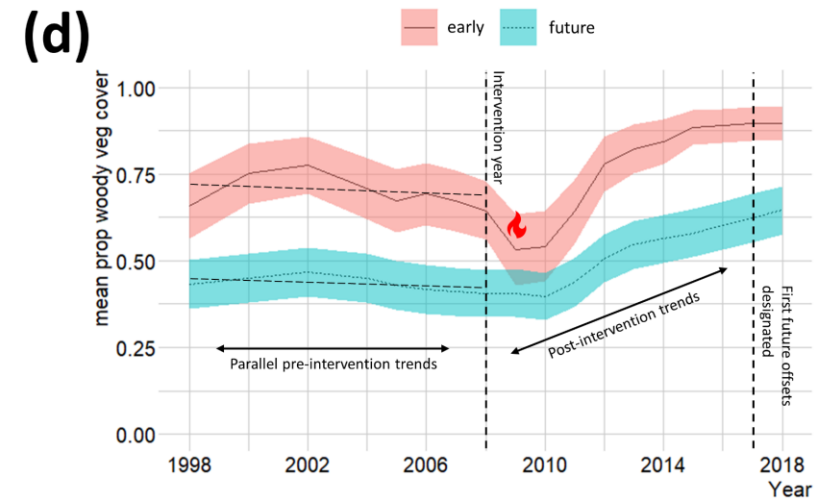
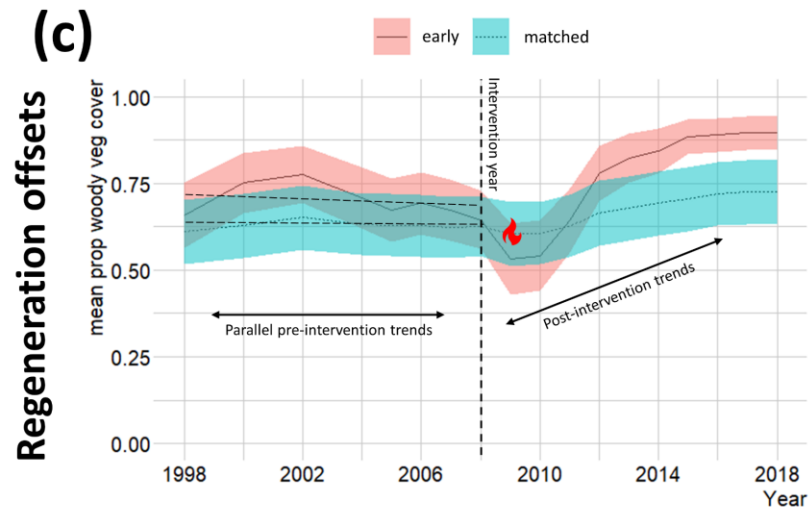
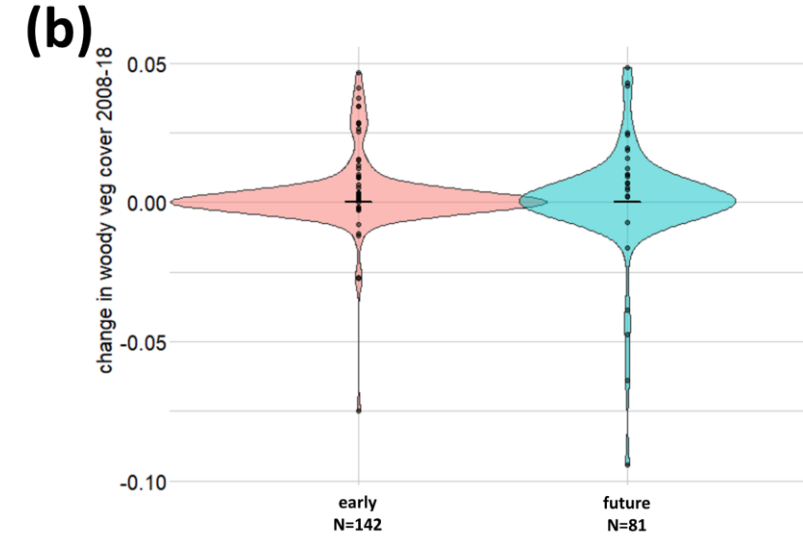
Blue: what would
have happened
anyway

Orange: what the
projects claimed
would happen

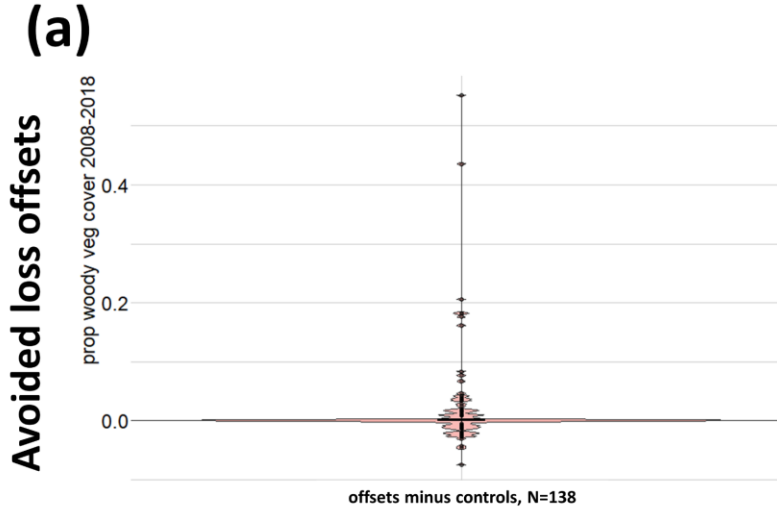
Matching with non-adopters



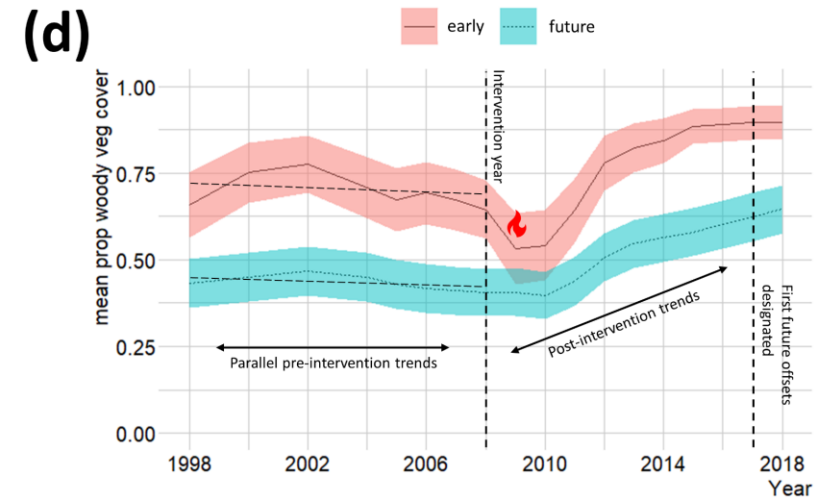
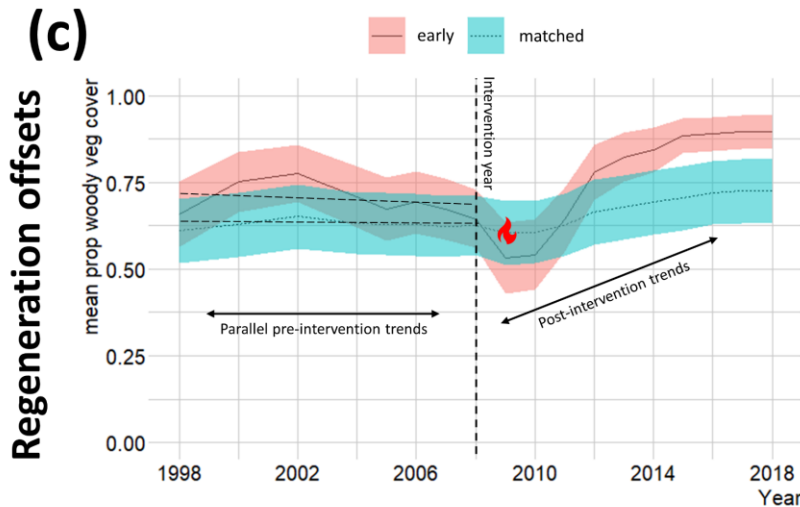
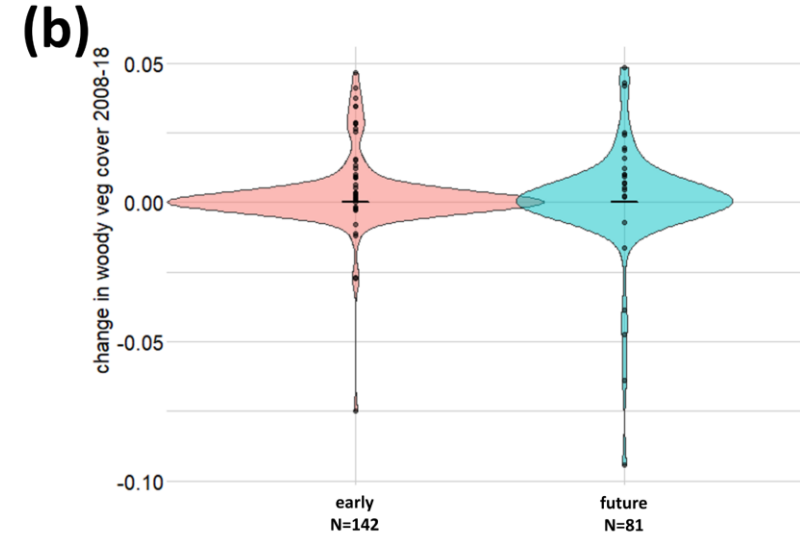
Comparison with future offsets



Matching with non-adopters



Comparison with future offsets



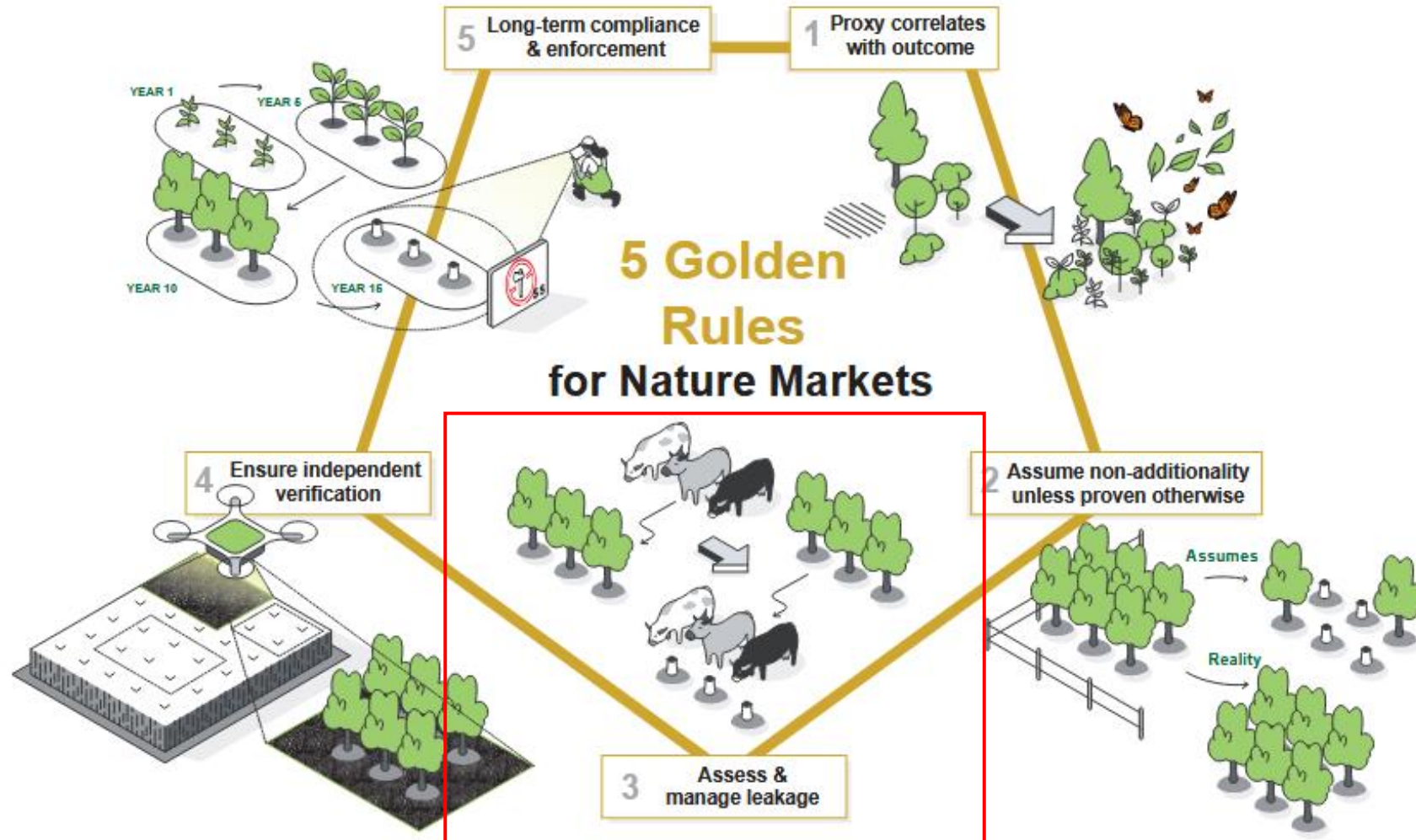
No difference
between offsets and
controls for 47% of
sites

Controls
outperformed
offsets for 22% of
sites

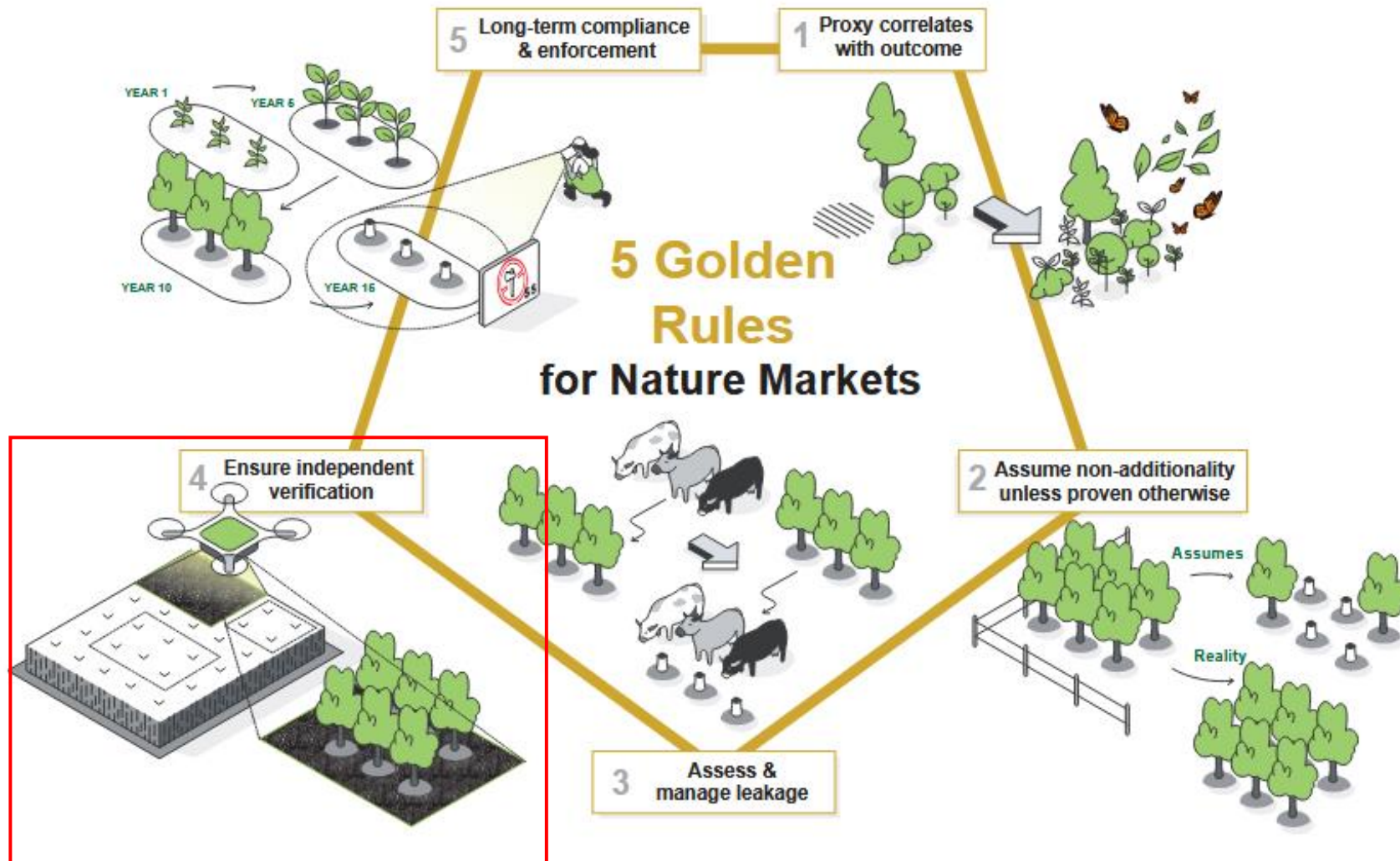
Offsets
outperformed
controls for 30%

**For 7, offsets
worked well**
(prevented loss of
>10% vegetation)

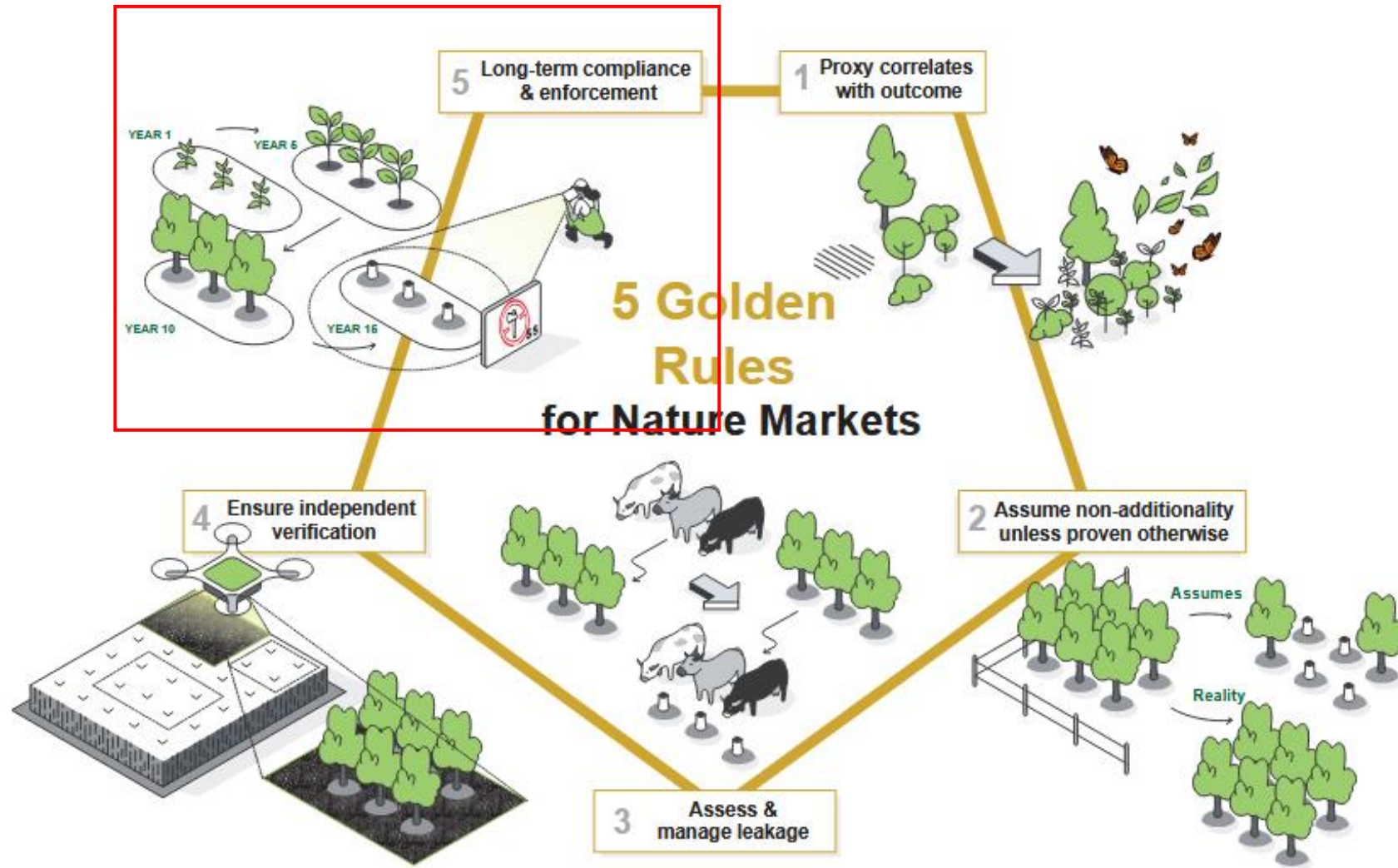
5 rules for nature markets: 3) leakage



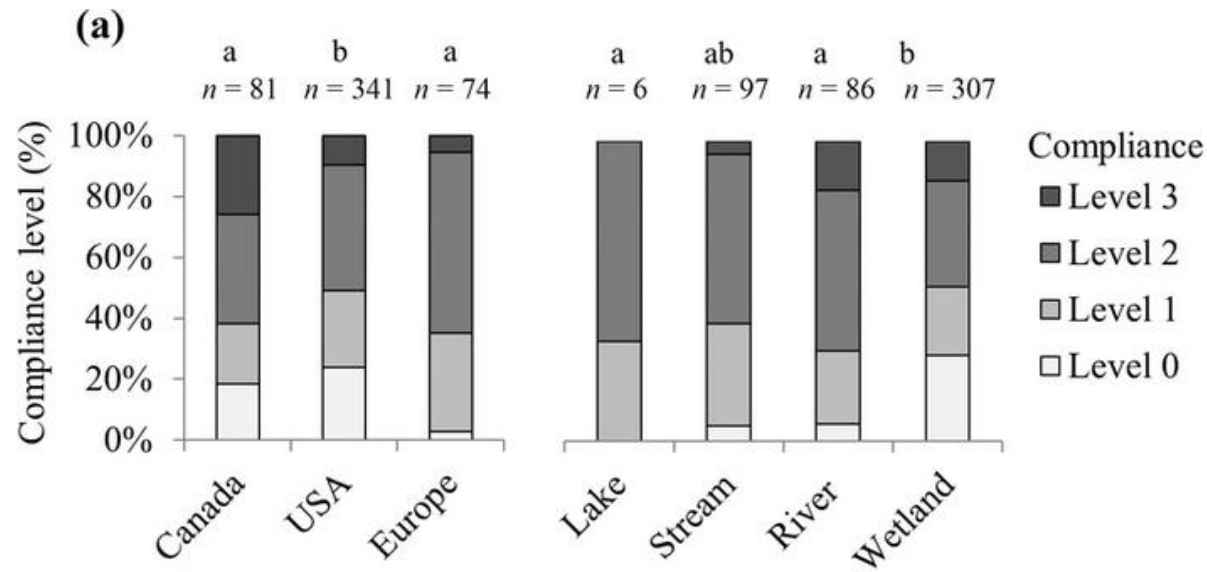
5 rules for nature markets: 4) transparency



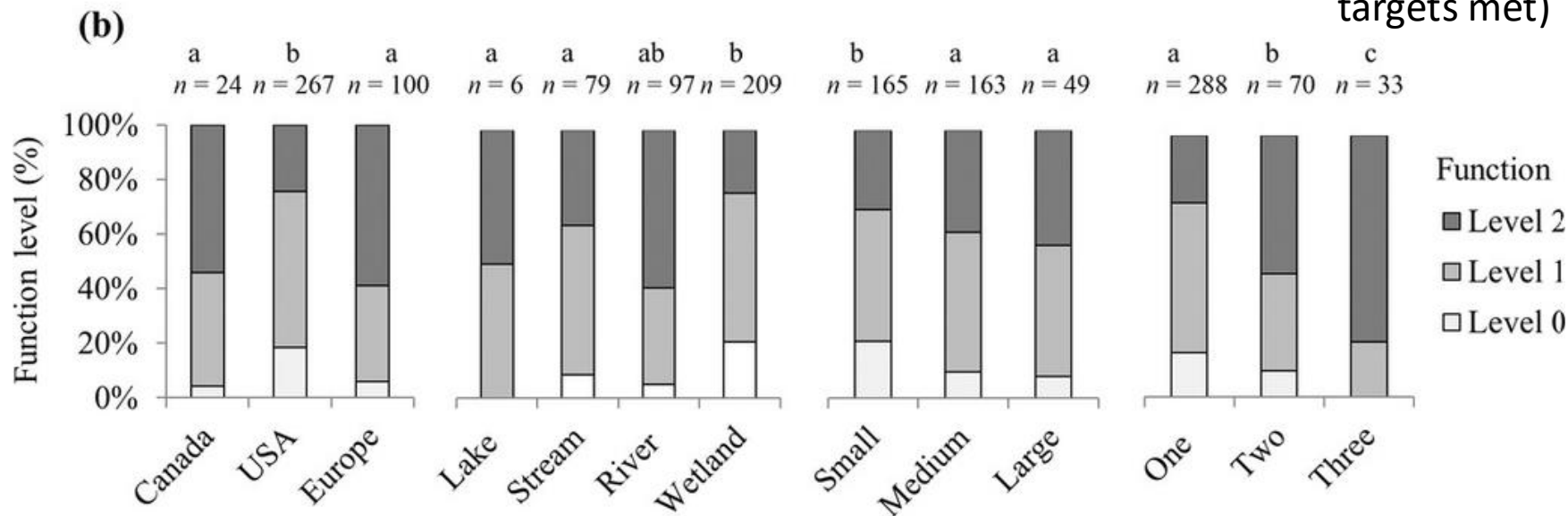
5 rules for nature markets: 5) governance



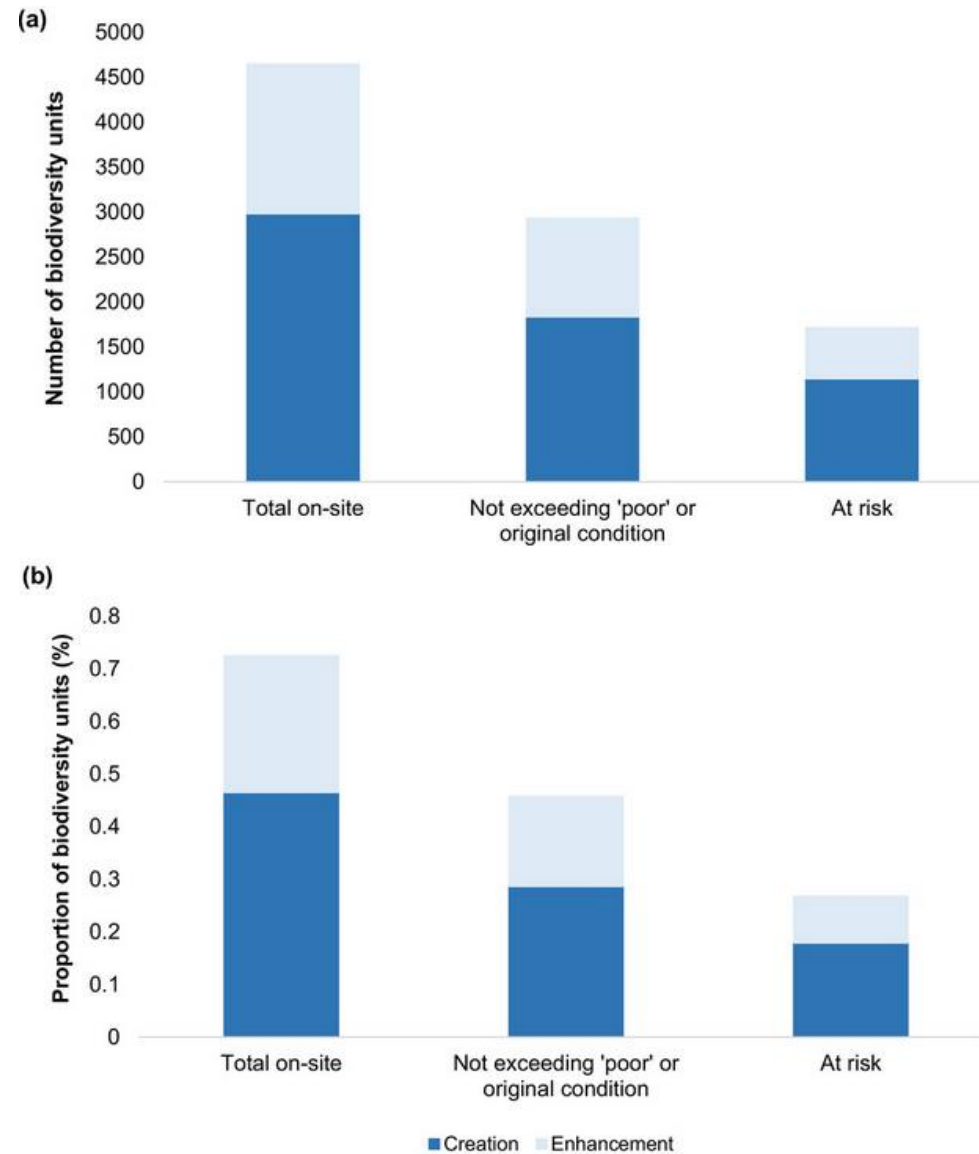
Long-term governance in offsets



(0, noncompliance, 0–25% of requirements met; 1, partial compliance, 25–90% of requirements met; 2, full compliance, 90–110% of requirements met; 3, overcompliance, >110% of goals met). Function scores (ranged from 0 to 2 (0, no functionality, 0–25% of ecosystem properties functioning as desired; 1, partial functionality, 25–90%; 2, full functionality, >90% of declared targets met)



Long-term governance in BNG



Nature market	Tested outcome variable			Additionality		Leakage		Independent verification		Credible path to addressing non-compliance			
	Does the nature market issue credits on the basis of some form of direct measurement of the state of nature?	Does the nature market require the remeasurement of that state of nature using primary observations throughout the crediting period to ensure that the state of nature is changing in line with expectations?	If the nature market uses a proxy outcome, has it been empirically demonstrated that the proxy outcome correlates strongly with the desired policy outcome?	Does the nature market documentation include some attempt to estimate the quantity of additional benefit from projects and the magnitude of additionality of credits?	Has a robust impact evaluation comparing the outcomes of the nature market against an unbiased credible counterfactual demonstrated that the amount of additional gain on average aligns with that claimed?	Does the nature market acknowledge leakage and make any adjustments to the number of credits allocated to account for leakage?	Does the nature market documentation acknowledge that it cannot be ruled out that leakage may approach 100%, and therefore use conservative estimates of leakage in its calculation methods?	Are spatial data delimiting projects and credited areas in the nature market publicly available?	Where projects are claiming outcomes that cannot be verified through remote sensing, are all the site-specific data used to support the claim publicly available?	Is the regulator or a third party conducting and publicly reporting ecological monitoring to evaluate ecological changes at some project sites?	Is there evidence that the regulator is taking enforcement action in the majority of cases following the detection or reporting of non-compliance?	Does the regulator have powers to revoke credits that have been issued if ex post monitoring demonstrates non-compliance?	Does the regulator use this power in the majority of cases where long-term non-compliance has been demonstrated?
Biodiversity Net Gain													
US wetland mitigation													
Victoria biodiversity offsetting under native vegetation regulations													
US species conservation banking													
Australian carbon market (HIR method)													
California forest carbon offsetting scheme													
International voluntary carbon market—REDD+													
International voluntary carbon market—ARR													

Criterion met

Criterion partially met or variation in methodologies used within the nature market with varying standards

Criterion not met

Insufficient information to make judgement

DON'T DO THESE THINGS

- Don't make (all of the) the outcome variable(s) something you can't check from space
- If you want additionality, don't give credits for things where you can't tell if they would have happened anyway (ie things with low up-front costs)
- Don't allow land managers to opt-in to selling without a competitive tendering mechanism, tight additionality tests, or obvious improvements relative to a static counterfactual – will attract mostly non-additional gains
- Don't concede robustness to voices that want lower barriers to entry – it will bring the whole scheme down