Technical Note: Understanding Risk of Reversals in Nature Based Removals

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There is often the misconception that Nature Based Removals are at higher risk of reversals than removals from other sectors. In fact, removals from all sectors carry a certain risk of reversals (though some are more apparent than others) and should therefore be treated equally under Article 6.4 guidance on removals.

This misconception is fueled by two factors:

- Reversal events in nature, like deforestation or wildfires, are dramatic and visible, while forest regrowth or compensatory policy measures are difficult to readily perceive. Reversals in other sectors are not as visible.
- At the same time, there is a widespread misunderstanding of the difference between carbon stocks and carbon flows in all sectors. This is exacerbated by a misunderstanding about accounting for forest carbon, which builds in a certain amount of natural forest die-off.

Regardless of the sector where removals come from, climate policy mechanisms have been designed to address potential risks (e.g. buffer pools, insurance among others).

KEY TAKEAWAYS: The data below illustrates several points supporting a sector-agnostic approach to managing the risk of reversals from removals under Article 6.4:

1. The risk of reversal for REDD+ is low: less than 1% per decade.

2. We can differentiate source of risk into localized geographical factors ("proximate") and deeper categorical factors ("underlying drivers"). **Both** are dynamic.

3. Categorical risks of reversal are expected to rise in the future –in part due to decarbonization of other sectors –unless incentives for REDD+ increase.

4. Under reasonable expectations, land-sector mitigation today is cost-effective, even if it is reversed in the future.

A. Can we quantify the statistical risk of reversal?

Yes. Overall, the global **average gross loss of forest carbon stock** was **<1% per year during the period 2000-2019**.[†] These gross losses were **more than compensated** by forest carbon removals during this same period, in all biomes, resulting in a **net gain in carbon stocks**. *The expectation of 100% reversal would vastly overstate the risks.*[†] Xu et al. 2021.

Table 1. Changes in terrestrial carbon stocks (2009-2019). Xu et al.2021, clipped from Table 1.

Biome.	2000 Carbon stock (PgC C)	2019 Carbon stock (PgC C)
Boreal		
Forest	27.61	28.07
Nonforest	13.04	12.90
Total	**40.65**	**40.97**
Temperate		
Forest	56.45	56.85
Nonforest	6.95	7.48
Total	**63.40**	**64.33**
Tropical moist		
Forest	150.66	150.28
Nonforest	3.44	4.06
Total	**154.11**	**154.34**
Tropical dry		
Forest	27.47	29.42
Nonforest	26.19	26.33
Total	**53.66**	**55.75**
Other biomes		
Forest	9.69	10.45
nonforest	54.05	54.78
Total	**63.74**	**65.23**
Global		
Forest	271.97	275.15
Nonforest	104.06	105.95
Total	**376.03**	**381.09**

Graphic 1. Interannual variability in stocks, emissions, and removals (2000-2019). Xu et al. 2021, Figure 5. There is no trend that would indicate increasing emissions in any biome over 20 years.
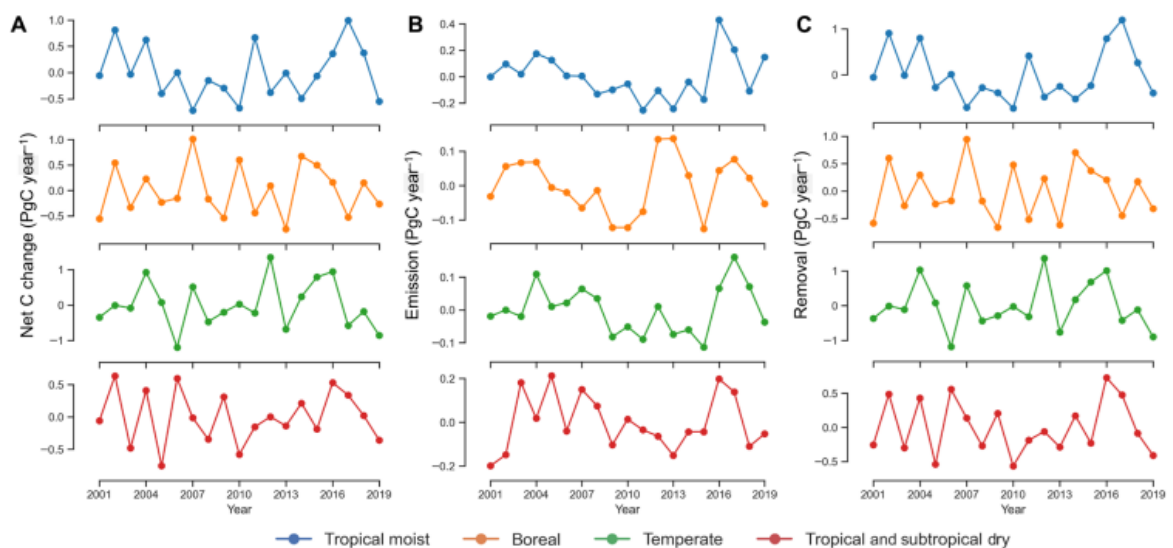
B.   **Can we identify the different types of risks of reversals?**

Yes. As far back as 2002, we understood that risk factors fit into two categories: **proximate factors** and **underlying drivers.**[†]

- **Proximate factors** can be mapped geographically and associated, through spatial statistics, with measured deforestation. These factors account for *geographically specific* risks.
- **Underlying drivers** emerge from the interaction of global market forces and other factors. As a result, they are less predictable, temporally and spatially. However, we can attribute emissions to such drivers *ex post facto*.[‡] These drivers account for *categorical* risks.

Annual global emissions from forests stem from the combined effects of these two risk categories. [†]Geist and Lambin 2002. [‡]E.g., Lapola et al. 2023 for the Amazon forest.

C. Are risks expected to change in the future?

Yes. The process of decarbonization of other sectors plus other factors are expected to **increase** pressures on forests. As explained by Busch et al. 2019, projections indicate that **deforestation rates will go up** in the absence of carbon incentives (please see Graphic 2 below). Therefore, the protection of existing forest stocks –even keeping them at static levels –will **require increasing incentives if we are to counter-balance these increasing pressures**.

> **Graphic 2.** Carbon prices must rise to >$50/t to maintain static levels of deforestation. Busch et al. 2019. Supplementary Fig. 6b
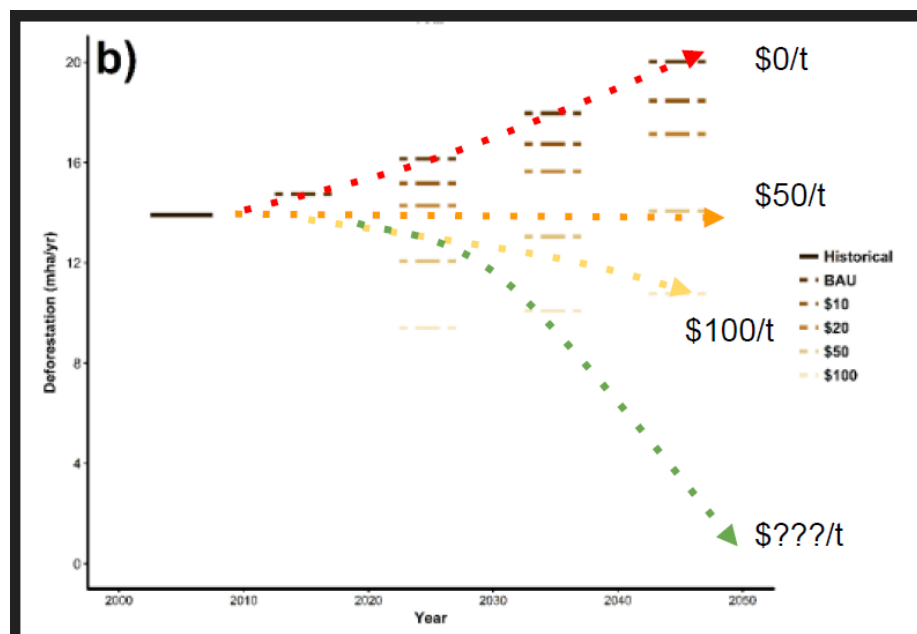
D.   Can we quantify the effect of policy interventions and incentives, even in historically low-risk areas?

Yes. Limited examples demonstrate a measurable effect of policies to protect forests.

> **Graphic 3**. Policy interventions in Guyana had a measurable effect in keeping deforestation low. Roopsind et al. 2019.
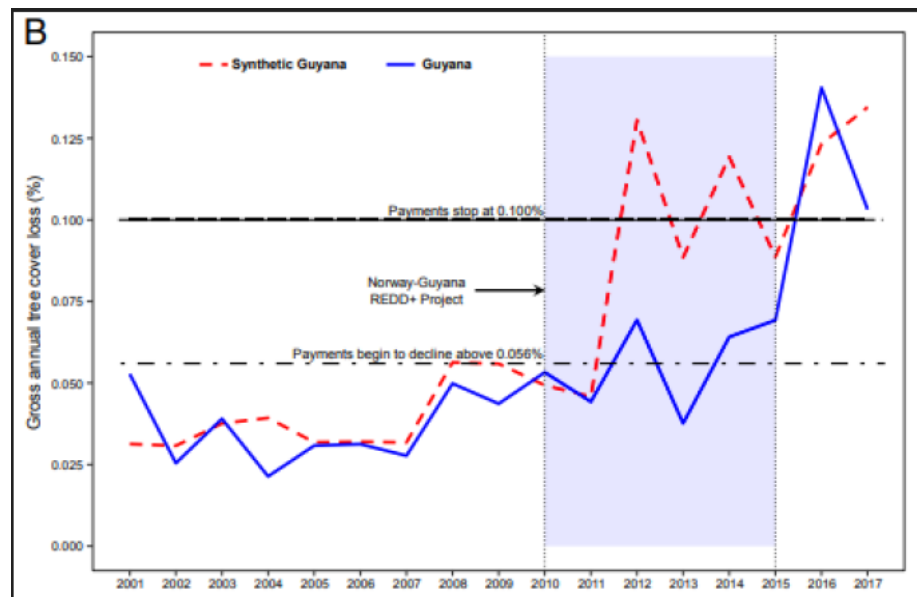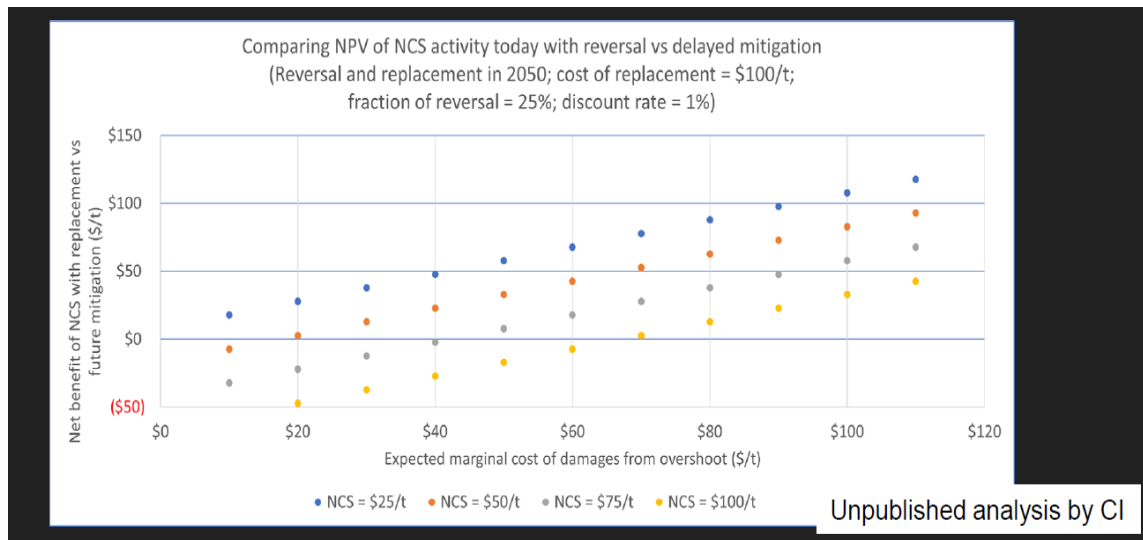

> **Graphic 4.** Policy interventions in Guyana had a measurable effect in keeping deforestation low. Roopsind et al. 2019.
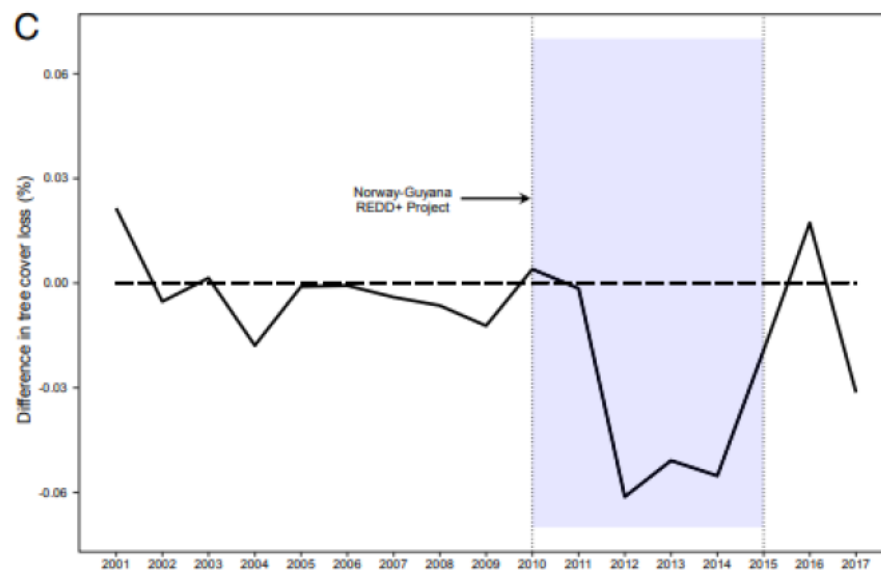
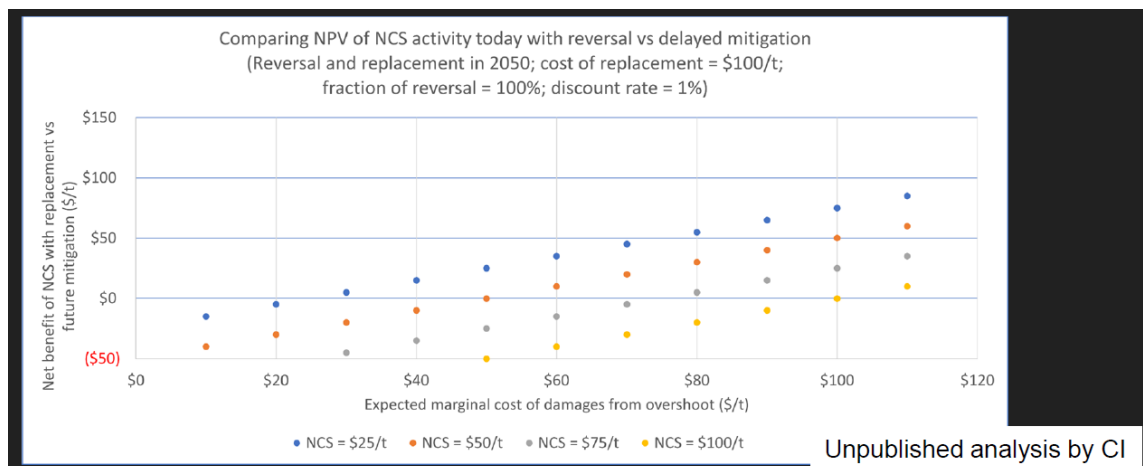## E. Could Nature-Based Removals be worthwhile, even if reversed?

Yes. Under reasonable expectations, nature-based removals is almost always worth doing today, even if we expect 100% reversal in the future (which is unlikely).

Graphic 5. Comparing Net Present Value (NPV) of NCS activity today with reversal vs. delayed mitigation. Unpublished analysis by Conservation International.

Comparing NPV of NCS activity today with reversal vs delayed mitigation
(Reversal and replacement in 2050; cost of replacement = $100/t;
fraction of reversal = 25%; discount rate = 1%)

Unpublished analysis by CI

Yes. Under more realistic expectations of reversal rates and discount rates, the case for NCS today is even stronger.

Graphic 6. Comparing Net Present Value (NPV) of NCS today with reversals vs delayed mitigation. Unpublished analysis by Conservation International.

Comparing NPV of NCS activity today with reversal vs delayed mitigation
(Reversal and replacement in 2050; cost of replacement = $100/t;
fraction of reversal = 100%; discount rate = 1%)

Unpublished analysis by CI

Graphics 5 and 6 are results of an internal analysis that compares the net present value of land-based mitigation to the social costs imposed by climate damages in scenarios that overshoot 1.5 degrees. The figures illustrate that near-term climate mitigation is valuable because it reduces the risk of overshoot and its associated damages. In these figures, any investment

above the $0 horizontal line is cost-effective, globally. These analyses include significant levels of future reversal, which is compensated by other mitigation in 2050 at a cost of $100 per ton CO2-e. CI can conduct this analysis for any time period, at any cost for both types of mitigation, any discount rate, and any level of reversal.

Annotated list of References

Annotated list of references with hyperlinks, which taken together, make a compelling case for the value of investing in land-based mitigation, especially tropical forests.

- Xu et al. 2021. Changes in global terrestrial live biomass over the 21st century. Information in the "Carbon emissions" section of the results, when summed across categories, indicates that the average rate of loss of tropical forest carbon was approximately 0.6% per year for the study period, 2000-2019. Figure 5 shows no rising trend in emissions for any biome during this period. Table 1 shows that overall terrestrial carbon stocks increased in every biome, with removals more than compensating for emissions

- Geist and Lambin 2002. Proximate Causes and Underlying Driving Forces of Tropical Deforestation. The authors were among the first to separate the effects of proximate causes, which act locally, and underlying driving forces, which act globally or regionally. These concepts help us to understand the sources of risks to tropical forests, how to address them, and how to think about additionality as related to dynamic risks, not solely historical emissions.

- Lapola et al. 2023. The drivers and impacts of Amazon forest degradation. The authors showed that Geist and Lambin's conceptual framework can be extended to tropical forest degradation (beyond deforestation) to explain trends in Amazonian forests.

- Busch et al. 2019. Potential for low-cost carbon dioxide removal through tropical reforestation The authors linked historical empirical data on land-use change (deforestation) to economic drivers as a means of estimating the cost of future reforestation across all countries in the tropics. In the course of the analysis, they estimated the future rates of deforestation and reforestation under a range of carbon price scenarios (including $0 per ton CO2-e), projecting that economic drivers will cause future deforestation rates to rise in the absence of compensating incentives to keep forests standing. Figures illustrating these future paths can be found in the supplemental information.

- Roopsind et al. 2019. Evidence that a national REDD+ program reduces tree cover loss and carbon emissions in a high forest cover, low deforestation country. The authors found strong evidence that REDD+ payments were effective in keeping deforestation emissions about 35% lower than they would have been in the absence of payments, and they documented that deforestation rates rose by 200% when payments were withdrawn. In this case, even relatively small incentives were sufficient to counteract risks driven by global market drivers. This is illustrated in Figure 3.

- In addition, Schwartzman et al. 2021 showed how temporary emissions reductions can lead to permanent results. Figure 1 shows a number of hypothetical emission pathways and the corresponding impacts on atmospheric GHG levels. Mathews et al.

2022 reached a similar conclusion using an established Earth system climate model. A 2022 report published by WRI found that tropical forests yield disproportionate cooling benefits compared to other biomes, when other biogeochemical processes are taken into account, suggesting that they should be a high priority for investment.