

## Coining one currency for nature

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Collective humanity is at a critical juncture. Biodiversity and climate are both changing rapidly, pushing us towards a biosphere our species has not known (1). For climate and biodiversity change, our efforts to halt both are not functioning (2, 3). We have a 1.5 degrees Celsius target for climate change and some understanding of how can get there (4), but such agreements and targets are not enforceable. For biodiversity the situation is worse. There is a body that regulates goals for biodiversity change, but I would argue that our 23 Targets (5) are not close to agreed by the community. Importantly, they don't recognize that the mechanisms of the service of biodiversity are borne of biodiversity itself, and that the uncertainty of this relationship is unknown (6). For both biodiversity and climate change I blame our failures on no individual. Our current economic paradigm has locked us into a trajectory that feels to have become unstoppable.

In parallel, investment in nature tech start-ups is growing, with companies aiming to monitor biodiversity for the betterment of humanity. My impression is that these companies don't really know what they're doing. I don't think that's on them. These companies are wanting to do the right thing, but something crystalline is not coming from us as biodiversity researchers. There is now I think a significant risk that these tech companies find ways of monitoring biodiversity at scale in real-time, but they end up building systems that optimize parameters from the literature that we know are not correlated with metrics that are meaningful. This will be compounded when that same problem occurs independently across tech companies, such that collectively we will measure metrics that are not meaningful, and that don't map between one another.

One view is that we need transformational change of the economic paradigm (7). That might be an ideal, but I don't think it's pragmatic, and I'm increasingly convinced there won't be many ways in which we can say it has worked. Within our current paradigm we have the TNFD (Taskforce on Nature-related Financial Disclosures; (8)), but I'm not convinced that will work either, since it doesn't yet regulate or enforce metrics. But I think there could be other ways. One thing that occurred to me is that maybe there is an analogy we can draw in how life evolves check and balance mechanisms. Perhaps we can take inspiration there in how we might solve the biodiversity crisis. These check and balance mechanisms are co-opted from mechanisms that already exist, and all of them can only occur within the set of contingent lineages of organisms that have already evolved. Think of life selecting for genes that up or down regulate themselves or switch off and on other genes, or hormones that up or down regulate the secretion of other hormones. Co-options are selected on co-options, such that when we look at life now, we see an entire history of improvised selections for self-regulation. For biodiversity change, I think the pragmatic approach is that we need to co-opt something that already exists, that can self-regulate us within a planetary boundary we know is at least not definitely unsafe.

One potential co-option I think has been figured out for us already: the carbon coin (9). The philosophy of the carbon coin is that central banks should back a new form of carbon currency, that can be issued to companies when they make some action to mitigate or capture carbon. Whereas cryptocurrencies are mined by using carbon to run calculations, a carbon coin would basically be mined by reducing emissions in the atmosphere. Two crucial outcomes are that it

would be a single global carbon standard, and that it could ultimately help to self-regulate towards net zero.

If a carbon coin were to happen, there's then a question as to whether that could be sufficient to solve both the climate and biodiversity crises together. I think that's unlikely. There are too many ways in which climate change mitigation is counter to biodiversity change mitigation. So what would life do? I think we need an additional check and balance currency: the nature coin. As in carbon coins, a nature coin would represent a single global standard that facilitates self-regulation. As far as I know, biodiversity researchers have not been talking about a nature coin or currency, that would be backed and issued by central banks. A lot of the debate is about the biodiversity metrics we should be tracking (10), which is important but not overly I think. Mass extinction events are caused by rapid environmental change (11). They are not caused by the choices we make on the biodiversity we track. If we can find a way to put the brakes on environmental change, and allow the Red Queen to catch up (12), it might be that everything else emerges organically.

Equally, it might not. I think we need to at least guide the way in which we down-regulate. If we don't, we risk mitigating inconsequential activities, either because their effect size is smaller than we anticipated, or because their effect is actually inherited from somewhere else. To do that, we need a reasonable model that guides our decisions. We can then track a conjunction of anthropogenic variables from space or remotely, combine that with our model predicting biodiversity change, and then link that to a new global currency that will self-regulate those variables towards bending the curve. Entities would be awarded a nature coin only when pressure change has been confirmed remotely, reducing the likelihood of false reporting. We would still need to monitor future biodiversity, but that comes secondarily I think to confirm that the currency is functioning. And then if it's not, we use that future record to refine our model of biodiversity change.

Assuming we need a nature coin, there is then a question as to what should be attributed value. If a carbon coin is designed to stabilize global temperature change, then what should a nature coin be designed to stabilise? That's a punishingly difficult question. We don't really know specifically what's important, and what's important varies depending on location, the service in question, and multiple other variables. One thing I will say though, is that we need to realise that each individual means through which we measure biodiversity is to some extent capturing the variation of others. I would agree that we definitely don't want one metric (13). But I also don't think we need all of them. I think we need the minimum number such that we capture enough of the uncorrelated ways in which all are collectively important. That is then manageable, and perhaps more crucially and hopefully, enough.

We then need a target or a planetary boundary, that guides the nature coin in the manner of 1.5 degrees Celsius for the carbon coin. Given the complexity of biodiversity, I would argue that if setting a target or planetary boundary feels like guessing, then we should be very reluctant to do it. The stakes are really too high, and the realised mechanisms of the biosphere too complex. But regardless, from the things we do know, I think we can at least say some things. I know that as I write this sentence, civilization has not yet collapsed, and that right now I continue to exist in a biosphere that is suitable for humanity. We are moving in a very concerning direction, and lag effects may be such that we could already be over-committed. But otherwise, independent of the issues of our own economic paradigm, we are where humanity can cope. We don't fully know how the mechanism of the biosphere works, but we know that what it propagates at present is safe. For certain, it seems unwise to set a boundary at any time in which anthropogenic drivers or climate change are more intense than at present. We cannot know the consequences.

So given that, what does that make our target? I think our global target needs to be anthropogenic pressure oriented. Let's bring drivers to a point at which we can with some certainty say that our key biodiversity variables will not jump around much lower than where they currently are. Collective humanity *could* regulate drivers, and then we bet the biosphere and our model on two fronts: that anthropogenic activity is not already over-committed, and that averting mass extinction can then emerge organically. Such a system doesn't need to be certain. Science is not. A system in which our models suggest 95 of 100 biospheres will reach self-regulation would be enough for me.

If a carbon coin happens, we need to be ready for the economists. What are the set of things we can do to prepare? My intuition is that there are at least seven big ones: 1) We need to be confident that the anthropogenic variables we measure do explain change in intactness. To do that I think we need more models built on the basis of causal inference (14); 2) we need to be confident that through valuing only some set of biodiversity metrics, we are not going to overlook something important; 3) we need to get better at building models that consider multiple anthropogenic variables together, such that we can be confident we will not overlook surprising high magnitude interactions; 4) we need to be better at accounting for uncertainty by incorporating variation predicted by temporal or spatial autocorrelation (15); 5) we need to sample biodiversity in space across more locations and across a greater breadth of anthropogenic intensities (16); 6) we need a consistent global monitoring system in place so we can track biodiversity at future intervals (17), to check the currency is working; and 7) we need to have an infrastructure in place that we can use to track change in anthropogenic variables from space or remotely at high resolution (18).

Please, we need to take a step back. We need to realise that what we are doing is not working. We need to think of humanity a thousand years from now, pondering to themselves why they started trading coins for nature. We need to ask ourselves what life would do.

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