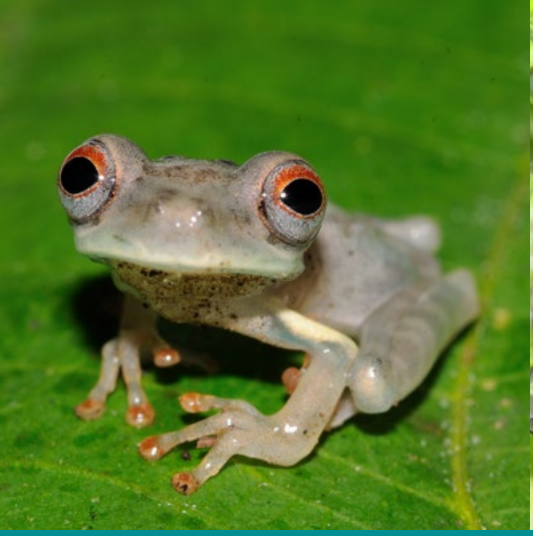
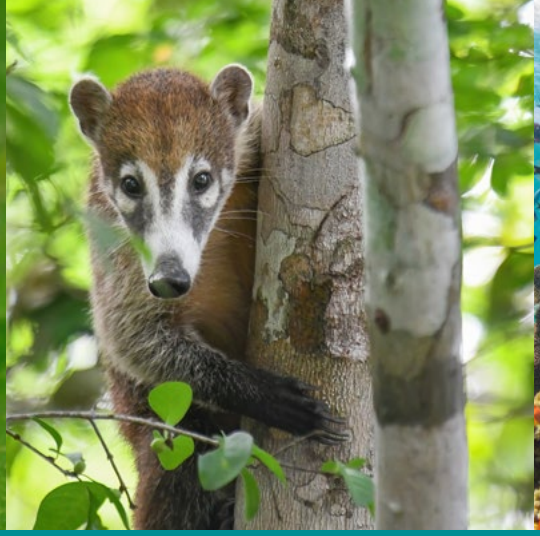
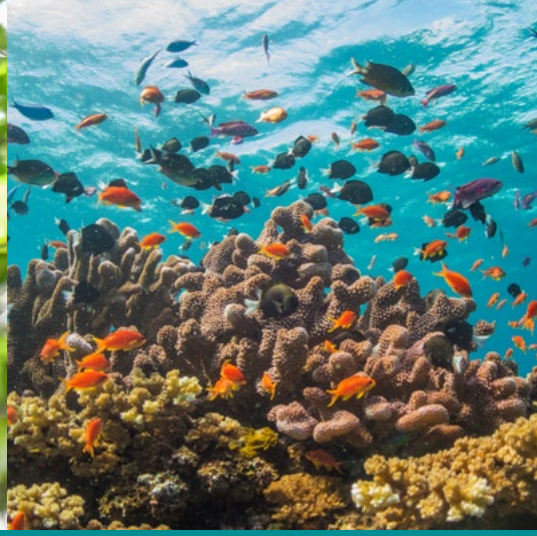

Identifying an agreed unit of biodiversity change for inclusion in a biodiversity definition

Results of a consultation exercise, 19 December 2022 - 31 January 2023

Dr Tim Coles, OBE – CEO rePLANET

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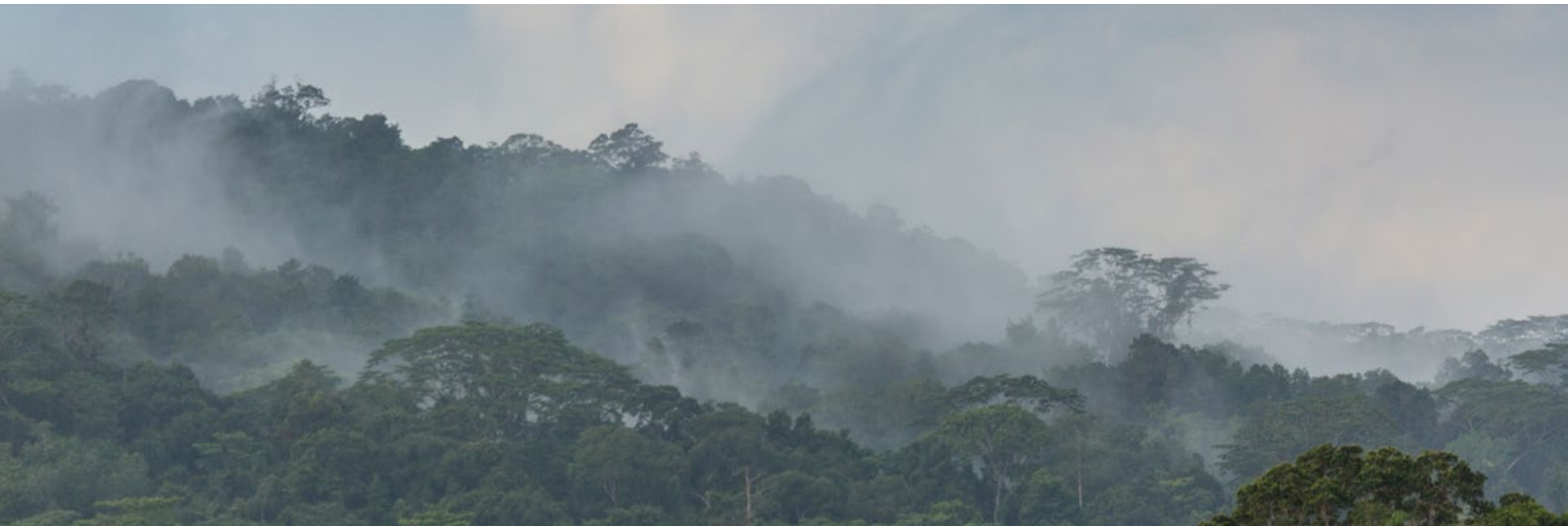


Summary

This report summarises the results of a consultation exercise requested by the World Economic Forum and Verra on how a biodiversity credit can be defined. The approach used for this consultation was to pose a series of questions about different elements of how a biodiversity credit definition could be formed and then describe the arguments used on all sides to answer each question. A suggested recommendation was then made to resolve each question. Questions covered in the review include:

- whether we need a quantifiable unit of biodiversity change
- fungibility
- additionality
- can the market solve this problem without intervention
- should biodiversity credits be linked to global biodiversity targets exclusively
- applicability of credits to all ecoregions
- can area alone be used as a measure of biodiversity uplift
- size of area unit to be used
- does time need adding into the definition
- permanence issues
- stacking criteria with other credit types
- do we need a Nature based credit
- can biodiversity be measured by process type approaches such as Climate Community and Biodiversity (CCB)
- can biodiversity be measured by threat reductions
- can biodiversity be measured by indicator species, habitats or threatened species
- are surveys of complete taxa needed
- costs of monitoring
- how many taxa need monitoring
- how tokenisation schemes could work

The resultant definition proposed is "A unit of Voluntary Biodiversity Credit (VBC) is a 1% gain per hectare in the median value of a basket of taxa that encompass the conservation objectives for the site or a 0.001% reduction in the cumulative extinction risk scores for all species on the submitted site."

This definition works for the Wallacea Trust and Verified STAR methodologies and can be used by Value Nature and Nature Credits to value their tokens and by EKOS to confirm the value of their Sustainable Development Units. It is also in line with the integrity principles outlined in the recent WEF and IIED publications.

Introduction

There is increasing interest in the concept of biodiversity credits especially after the agreements at COP15 in Montreal where countries have agreed to ensure 30% of their land, freshwater and marine areas are protected in a natural or seminatural state and that 30% of their degraded land, freshwater and marine areas are restored by 2030. In addition, Article 15 of the Global Biodiversity Framework was also agreed which requires countries to develop reporting systems for private sector impacts on nature. The private sector forms at least 60%

of the world's economy and without funding from this sector it is highly unlikely that government and philanthropic expenditure alone will achieve the 30 x 30 targets and slow rates of species extinctions.

One of the main barriers to private sector investment in conservation is the lack of an agreed definition of a unit of biodiversity change. Without being able to quantify how much biodiversity benefit is being achieved it is difficult to justify as part of an Environmental Social Governance (ESG) programme. The carbon credit market has an agreed upon unit of climate change: one carbon credit is 1 tonne of carbon dioxide equivalent either not emitted or sequestered. If a market is going to develop in biodiversity credits, then we need to agree a unit of biodiversity change to incorporate as part of the biodiversity credit definition.

Whatever definition we decide on for a biodiversity credit will need to be applicable in all 1300 ecoregions and habitats in terrestrial, freshwater and marine environments. Since a major market for these credits is likely to be from companies with Nature Positive ESG commitments it would be useful if the credit definition could help towards national and global biodiversity targets such as the 30 x 30 commitment or reduction in species extinction risks.

There is little disagreement on a broad definition of a biodiversity credit amongst biodiversity credit or token developers as some variation of the following definition: *A Voluntary Biodiversity Credit (VBC) is a tool to enable investment in nature conservation and can be broadly defined as a quantifiable unit of biodiversity using a scientific methodology.*

If we use this definition, then the next stage is to identify the quantifiable unit of biodiversity change so the definition can be completed. Imagine what would happen if the carbon credit definition hadn't identified a unit of climate change as 1 tonne of carbon dioxide equivalent and was simply a project that demonstrated GHG emission reductions or additional storage but then didn't define the quantity of these changes? You could get credits for projects that made miniscule changes alongside projects that made substantive changes, but both would be defined as carbon credits.

At an impromptu meeting (convened by WEF and Verra) of a number of biodiversity credit methodology developers and others working in the emerging biodiversity credit space at the Montreal COP15, it was agreed that there should be widespread consultation in a bid to obtain general agreement over a definition for a biodiversity credit and that this should be coordinated by the author. This report summarises the results of this consultation exercise over the period from late December 2022 to 31 January 2023.

The approach taken to identify a quantifiable unit of biodiversity in this report has been to ask a series of questions that look at different parameters and options for identifying a unit of biodiversity. Arguments from all sides to each question are then outlined and a recommendation made at the end of each section.

Recommendation: *The definition of a biodiversity credit needs to go beyond a general definition of intent and define a quantified unit of biodiversity.*

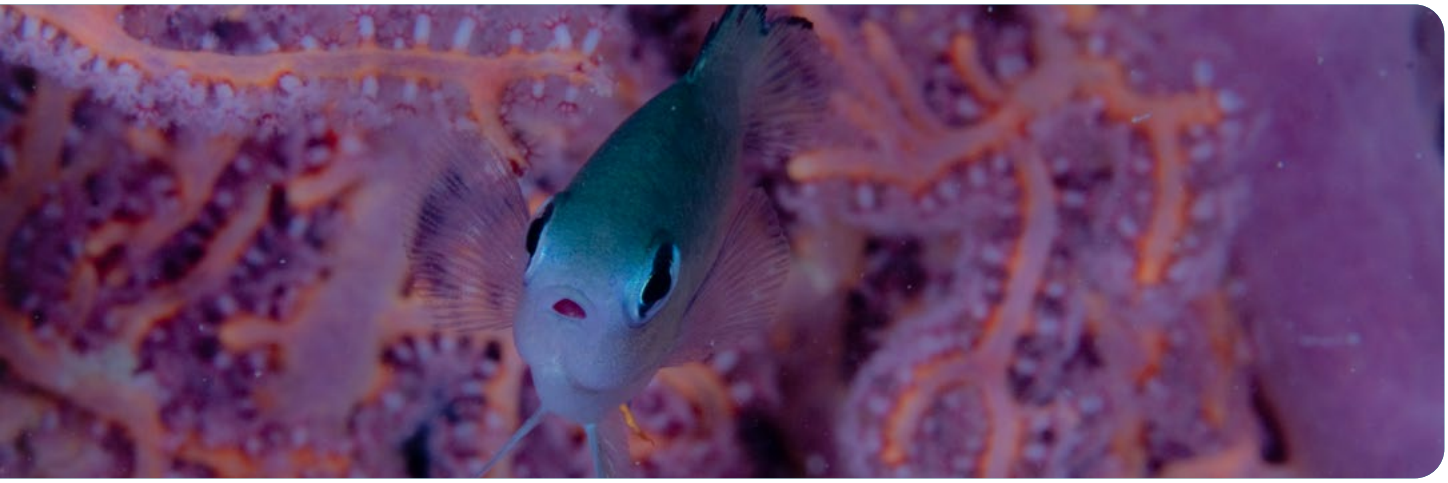
Does a biodiversity credit need to have additionality?

In the carbon world all credits issued need to demonstrate additionality – the purchase of the credit has resulted in an additional tonne of carbon dioxide equivalent not being emitted or sequestered. Having the concept of additionality embedded within biodiversity credits could be achieved by issuing biodiversity credits only where there is a measurable gain in biodiversity. That could be a gain achieved through ecosystem restoration or a gain achieved by maintaining existing high biodiversity levels against the threat of loss in the 'do-nothing scenario.' This would allow biodiversity credits to align with carbon credits in terms of claims.

The counter argument though is that including gain in the definition would then exclude biodiversity credits being used as a funding source for wildlife sites that are not under threat but are still struggling to keep running. It could also reward the bad actors – a community that has managed its wildlife well is not rewarded whilst those who have destroyed everything are then rewarded with funding, even in some of these cases additionality may be met. A community managed area is only as strong as the leadership of the community and if there is a change in leadership there can be changes of direction in approach to wildlife. In this case it could be argued that the well performing community should be rewarded in order to avoid a change of leadership and consequent loss of biodiversity and this would also act as a lesson to others.

There will still be cases though where a loss of management because of financial issues for a few wildlife reserves wouldn't necessarily lead to a loss of biodiversity and additionality could therefore not be demonstrated. These cases are likely to be relatively rare though and undermining the additionality criterion in order to include these rare cases in a biodiversity credit definition does not seem worthwhile.

Recommendation: *A biodiversity credit should be defined as a quantifiable unit of biodiversity gain and additionality will need to be demonstrated for all projects issuing biodiversity credits*



Does a biodiversity credit need to be fungible?

This was a request from a number of people at the start of the consultation process. However, the term fungible turned out to be deeply contentious with economists as they contend that it cannot apply to biodiversity or carbon credits. Despite this some from the carbon world argue that carbon credits are effectively (even if not technically) fungible.

Investopedia describes fungibility as implying that two things are identical in specification, and where individual units can be mutually substituted. For example, specific grades of commodities, such as No. 2 yellow corn, are fungible because it does not matter where the corn was grown; all corn designated as No. 2 yellow corn is worth the same amount. Commodities, common shares, options, and dollar bills are all examples of fungible goods.

Conversely, as an example of non-fungibility, if Person A lends Person B his car, it is not acceptable for Person B to return a different car, even if it is the same make and model as the original car lent by Person A. Cars are not fungible with respect to ownership, but the gasoline that powers the cars is fungible. Assets like diamonds, land, or baseball cards are not fungible because each unit has unique qualities that add or subtract value.

Carbon credits are non-fungible because the same credits with different vintages will have different market values due to perceived differing levels of Monitoring, Reporting and Validation (MRV) or because they are loss avoidance credits as opposed to sequestration credits. This lack of fungibility has not prevented a substantial Voluntary Carbon Market (VCM) from being developed and credits traded. However, without the definition of a unit of climate change (1 tonne of carbon dioxide equivalent either not emitted or sequestered) this market could not exist because there would be no accepted unit for quantifying the gains from buying a carbon credit.

When we assess a forest or a coral reef after say a five-year period of management and say it is better or worse than before for biodiversity, on what quantitative basis are we making that judgement? We must define a standardised unit of biodiversity gain (from loss avoidance where the gain comes from maintaining the current levels of biodiversity against the 'do nothing' scenario and restoration where the gain comes from increased levels of biodiversity). The resulting units are not going to be fungible, as - like the cars in the above example - they will have different qualities. However, they can be made 'interchangeable' or 'tradeable' through exchange contracts, because non fungible carbon credits are traded with discounts, premiums or other mechanisms that 'equates' one non-fungible carbon credit to another.

Recommendation: *The term fungible should not be used for nature markets.*

Do we need to define a unit of biodiversity gain, or can we leave this to different developers?

The main argument against designing an agreed definition of a unit of biodiversity gain is that whatever definition is agreed will prevent some of the existing methods being used. Innovation from the development of new ways of assessing biodiversity is a key driver of progress and having a single unit of biodiversity gain could stifle that innovation. Another argument is that biodiversity credits should only be developed for retirement by the primary purchaser as contributions to Science Based Targets for Nature (SBTN) or Taskforce for Nature-based Financial Dialogues (TNFD) commitments, so if there is no secondary market then common units are not needed. However, even in these cases surely a unit of measurement of the value of the contribution to TNFD or SBTN targets will still be needed? If primary purchasers do not intend to compare the benefits of different credits or sell them in secondary markets, then a common unit of biodiversity gain is not needed.

The arguments in favour of defining a common unit of biodiversity gain are:

1. Without a definition of an agreed unit of biodiversity gain companies will not be able to quantify the benefits of their investments in nature projects and compare progress with other companies in the same sector or costs of transactions in different geographies / for different conservation impacts. This will most likely slow investment by the private sector and bar the market from upscaling. Indeed, according to CPIC the lack of a definition of a biodiversity credit is already a main reason why there is so little private sector investment in biodiversity. Achievement of the Global Biodiversity Framework funding gap estimated at requiring an additional $700 – 900 billion a year, will require private sector finance and can't be achieved from governmental or philanthropic expenditure alone. Having an agreed unit of biodiversity gain will help facilitate this investment in the same way that a unit of climate change helped drive the carbon markets.

2. Carbon certification bodies are beginning to develop standards for issuance of biodiversity credits. Plan Vivo for example are launching their biodiversity credit standard in March 2023 based on the Wallacea Trust methodology. Verra who are by far the largest certification body in the carbon world are also designing a standard for biodiversity credits and for this will need a quantifiable definition of biodiversity gain. If we end up with differing definitions of a biodiversity credit between certification bodies it will cause confusion on the demand side (corporates), which would ultimately be of no interest to anyone. Hence, agreement on a unit of biodiversity gain is better sought early on, and all across the market.

3. Scaling a market requires there be an active secondary market at some point, and this will be stifled unless there is a quantifiable unit of biodiversity gain. Investors will be hesitant in making investment unless there is the opportunity to make a return on their investment from selling the credits. One of the main successes of the carbon markets has been the agreement on a quantifiable unit of climate change that has allowed investment to scale rapidly.

4 If a unit of biodiversity gain is not identified and one company invests over a five-year period and claims they have improved the general (unquantified) biodiversity of the site, and there is then a second investor taking over funding for the next five years and also claiming that they are improving overall biodiversity, how do you avoid double counting in this situation? You need quantification of units of gain so the benefits of each of the investors can be quantified and double counting of the same gains avoided.

A third way of looking at this is would be better to allow the demand side of the markets to decide which biodiversity credit definition is preferred, by letting the early pilot phase proceed through transactions without an agreed unit of biodiversity gain. This encourages innovation in approaches, but at the same time slows biodiversity investment until the winner in the market is apparent, which could take many years. However, this approach will not address the continued complaints from the demand side that it is confused about what actually is being sold to them. The Global Biodiversity Framework has identified a need for a significant increase in investment by 2030 (which is a short time horizon) in order to prevent catastrophic biodiversity collapse. Leaving the markets to sort out a 'winner' is likely to take too long for this time scale.

Recommendation: *The development of an agreed unit of biodiversity gain as the definition for a biodiversity credit, is likely to be necessary to scale the markets in the time scales needed. Having an agreed unit of biodiversity gain should still allow multiple scientifically proven methods to deliver projects that meet the agreed definition of biodiversity credits in the same way as occurs in the carbon markets.*

Should biodiversity credits be aligned with global targets?

Since biodiversity credits are aimed at Nature Positive claims and are above and beyond offset claims, then one way of distinguishing these differences could be to align biodiversity credits with the Global Biodiversity Framework (GBF) targets that were adopted at COP15. One of these targets is to conserve and manage at least 30 percent of the world's lands, inland waters, coastal areas and oceans by 2030. A second target is to restore 30% of degraded areas by 2030. The private sector will be involved in this process because article 15 of the GBF requires governments to ensure that large and transnational companies disclose "their risks, dependencies and impacts on biodiversity." Once companies have to start reporting, this leads to a requirement to measure and to set targets to improve.

Each country will be converting these global targets into national targets and reporting on progress at COP16 in 2024. One way that the private sector could align with these targets is by quantifying the biodiversity gain achieved in the national 30 x 30 estates from their investments.

However, there are many uses for a definition of biodiversity gain beyond just accounting for benefits in the 30 x 30 estate. The food industry has by far the largest impact on biodiversity worldwide and there is a move to regenerative farming approaches. Defining a unit of biodiversity gain which could then be measured, and the biodiversity benefits of regenerative farming quantified could then allow food companies to develop Nature Positive claims for some products grown in areas where there has been a significant biodiversity increase. Alternatively gains in biodiversity could be quantified and monetized by individual farmers as financial incentives to improve their land for biodiversity (particularly important in an era when state subsidies are declining). It is unlikely that food production areas even those adopting regenerative farming, would be included in the 30 x 30 estate. It is therefore important that the biodiversity credit definition should not just apply to 30 x 30 estate areas. Companies could still identify their biodiversity gain contributions to the 30 x 30 estates though and chances are these will receive preferential funding for biodiversity credits because of their alignment with global and national biodiversity targets.

Another way biodiversity gain could be expressed is by reducing the overall extinction risk to species using a Verified STAR methodology. The IUCN IBAT database contains the predicted distributions of all threatened mammal, herpetofauna and bird species in each 5km square worldwide. For any site a list can be produced of the threatened species that theoretically occur there. The list of species actually occurring at any site can then be verified by using eDNA techniques. For each threatened species IUCN has identified the main threats that are driving that species to extinction and then allocated a percentage importance to each of these threats. For example, a species may be threatened by hunting (20%), deforestation (40%), disease (20%) and invasive species (20%). Critically Endangered species are allocated 400 STAR global extinction risk points and if you have the last remaining population of a species entirely within the area you are supporting, and can eliminate hunting, deforestation and invasive species from the area, then you can be awarded 400 x 0.8 (note there is little you can do about disease) STAR extinction reduction points for saving that species. The overall extinction risk for all threatened species in a country can be calculated and the benefit that any company is providing in reducing the overall extinction risk levels can be quantified. This approach then allows a biodiversity gain (expressed as a reduction in extinction risk) to be linked to a national and global biodiversity target.

This system should be included in the overall definition because it works well particularly for areas with high numbers of threatened species. This system is most useful for identifying where green bonds or sovereign credit investment is targeted so that the most deserving of sites receive the investment within a country. It could also be used by the private sector to target which sites should be prioritized for biodiversity investment and this would then help concentrate their investment on the most beneficial sites.

However, it cannot be used as the sole method of quantifying change because of the following reasons:

1. In many sites around the world the eDNA surveys will reveal few or even no threatened species. Even where they do occur the invested sites will form a very tiny percentage of the overall global range of the threatened species which do occur. Biodiversity gains as measured in STAR extinction reduction scores will therefore be miniscule or even zero in cases where there are no threatened species, even though the investment could be restoring ecosystems and natural communities and populations

2 The verified STAR methodology works on the presence/absence of species at a site and reducing the probability of extinction by adopting measures to reduce the threats to that species in the targeted area. Increasing populations of some of the rarer species over time is not reflected in the extinction reduction score.

3 The STAR methodology works on mammals, herpetofauna and birds at the moment, so is restricted to land-based habitats. There are plans to add higher plants, fish and some invertebrate groups in the future which would extend the use of this approach to other habitats such as species-rich grasslands, coral reefs and freshwater lakes, which at the moment can't be assessed using this approach.

4 The percentage importance of each threat to a species is allocated on a global basis and at any particular site the actual percentage threats to the species' survival at that site may vary. Using the above example, the site being improved may have very little forest and the objective is to extend the area of natural forest with a planting scheme. Hunting has not been allowed anyway on the land for decades and there are no invasive species in this example. Instead of loss of forest amounting to 40% of the threats to this rare species, its' survival would be much more linked to the success in extending the amount of forest cover. The forest planting scheme is only scoring 40% on the risk reduction score but in this case it is closer to 100% of the reason the remaining rare species is likely to survive and increase long term at this site.

Recommendation: *Wherever possible biodiversity credits should be linked with national and global biodiversity targets either through assistance with the 30 x 30 estate or reducing national species extinction risk scores. Note in many cases both the unit of biodiversity gain in the 30 x 30 estate and the overall contribution to a country's species risk reduction score can be quoted. However, given the huge impact of the food industry on biodiversity and their interest in improving biodiversity on farmland which is unlikely to contribute to the 30 X 30 estate or affect national extinction risk reduction scores, the quantifiable unit of biodiversity change (and biodiversity credits) should also be applicable to projects that are not contributing to national or global biodiversity targets.*

Should biodiversity credits apply to all habitats and ecosystems?

Biodiversity credits will be most useful if they can be applied across all ecoregions and habitats. The Wallacea Trust methodology allows for this by identifying the taxa you would use to judge whether a particular habitat had improved over time in the case of a restoration project or maintained their biodiversity value in the case of an avoided loss project. Each of these taxa (either functional taxa such as soil invertebrates or zoological taxa such as butterflies) are then surveyed at multiple times using the same methods and sample sites so that changes in the taxa between times can be assessed. Species are then weighted by their importance (five-point scale based on rarity) and multiplied by their abundance (or total biomass of all species in the taxa in the case of many invertebrate taxa) on a five point logarithmic scale to produce an overall score for each taxon. The repeat surveys using the same methods, efforts, survey conditions and sample sites then produce an updated score for the taxon. A minimum of five taxa are surveyed and each taxon will have changed by a different percentage between surveys. The median value of taxa change percentages multiplied by the area in hectares then allows the number of biodiversity credits to be quantified. Just like the Consumer Price Index which uses different baskets of goods and services in different countries (selected to reflect what people are buying), the basket of metrics selected for different habitats will vary considerably. Where the types of projects being undertaken are very different, such as an arable farm in England being rewilded and a coral reef in Indonesia being protected from all forms of fishing including bomb fishing, there are no overlaps in the taxa being quantified. That is because we are not trying to increase breeding birds on a coral reef or piscivorous fish on a lowland arable farm! This approach of quantifying percentage gain either from restoration or avoided loss projects then allows biodiversity gain to be calculated for all habitats.

Other methods that quantify biodiversity gain against a baseline could also meet the criteria of applying across all ecoregions and habitats. Verified STAR could meet this requirement once other taxa are added to the system.

Recommendation: *A unit of biodiversity gain should be applicable across all habitats and 1300 ecoregions.*

Can area alone be used to quantify biodiversity?

One suggestion received was for a credit to represent one hectare of effectively conserved protected area each year. This has the advantage that it can be linked directly to the high-level CBD 30 X 30 target and would thus allow companies to directly invest in internationally agreed commitments. This is what is happening in the climate convention, where the target of 2°C is measured through volumes of CO_2 mitigated, and carbon credits are equally defined as tCO_2-eq, making it easy to link company work to global targets. Companies could then claim that (over and above any offset requirements) they have, as part of their Nature Positive targets under SBTN or TNFD, further contributed funding towards protecting e.g., 10,000 hectares of protected areas for a 10-, 20- or 30- year period.

The main disadvantages of using just area with annual credit issuances on sites within the 30 x 30 estate are:

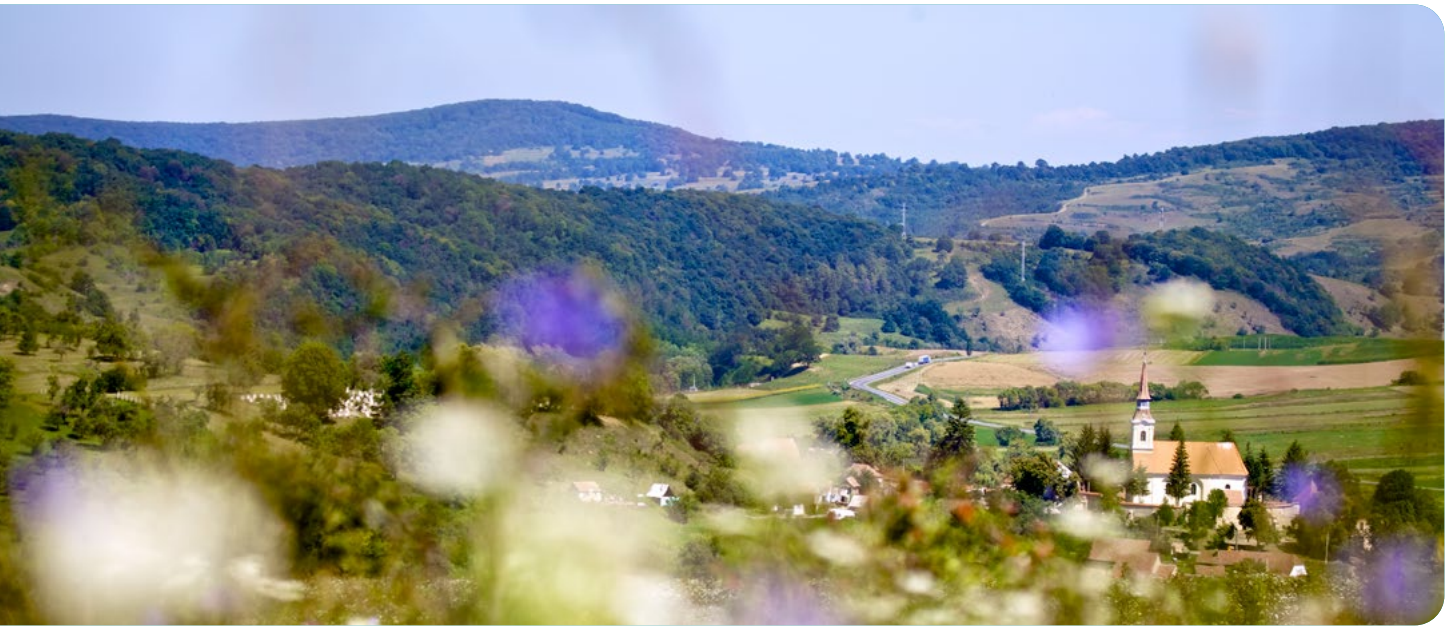
1. There are significant differences in the benefits to biodiversity of interventions at say a local nature reserve in a city centre and a national park in a lower quintile GDP country in the Tropics. Both may qualify as part of the countrys' 30 x 30 estate and investment in both would qualify on the hectares per year definition but there would be massive differences in biodiversity benefit.

2. Similar to carbon markets, biodiversity credits must respect the principle of additionality and like carbon it needs to measure the level of that additionality. Whilst the definition of additionality is whether the biodiversity improvements would have happened in the absence of the project, the levels of those biodiversity benefits will vary enormously. If the benefit to biodiversity (level of additionality) was not measured and only the area in hectares that is being protected used as the measure of success, then a protected area that is already mainly funded but needs some additional funding, for example to increase anti-poaching patrols, would be able to issue credits very cheaply because it had the threats to the protected area largely under control and funded. A lower quintile GDP rated country's protected areas, which suffer from chronic issues of continued degradation of biodiversity they host (i.e., paper parks problem; chronic weaknesses in management effectiveness as measured by IUCN METT score or UNDP GEF Protected Area Financial Sustainability Scorecard), would likely end up relying almost entirely on the biodiversity credit income and the funding would need to cover almost the entire costs of the protection. There is not a simple dichotomy between paper parks and well managed protected areas and there is a continuum of situations. This would create the same market bias as the current carbon markets where renewable energy credits can be sold for as little as $1 because there is little or no extra work required whereas ecosystem restoration where the credits are covering the entire costs are much higher. In the biodiversity world this would discourage purchase of credits from protected areas that really needed the funding and concentrate it on those areas that just needed a little extra in order to ensure the biodiversity remains intact.

3 For avoided loss projects the solution would be to measure the biodiversity at the start of the project in comparison to a reference site that represented what the avoided loss site would become. This would then allow comparison between avoided loss projects using standard units of avoided loss of biodiversity. There would need to be regular (3 – 5 year intervals) measurement of the biodiversity to demonstrate that the management had been effective in comparison to its baseline condition, so this work would be needed anyway. Key Performance Indicators (KPI's) would also be needed for the intervals between biodiversity assessments to confirm the project was heading in the right direction (e.g. levels of anti-poaching patrols, control of invasive species, reduction in illegal logging etc.). A key point is to have a Scientific and Technical Panel to peer-review these biodiversity loss avoidance or restoration claims as without trusted science, markets won't buy credits and for this we need an independent panel of leading experts in different taxa and ecoregions who can peer review the biodiversity claims for restoration or avoided loss projects. This is being funded by NERC and SERC through Nottingham University and a number of key academic institutions are keen on participating. Once formed this could provide a useful input to the certification bodies on the scientific rigour of biodiversity restoration or avoided loss claims.

4 The same argument applies to quantifying the biodiversity gains from restoration projects. If we want natural forests to be restored, agriculture to become more wildlife friendly or overfished reefs restored then we need a mechanism for issuing biodiversity credits or other incentives that pay for these restorations. Just measuring restoration benefits on a funding per hectare per year basis alone without any measurement of the biodiversity improvement, would skew the market to supporting the cheaper credits issued that might be producing much smaller biodiversity improvements.

Recommendation: *Biodiversity credits need to be linked to area, but will also need a quantified measure of biodiversity improvement or avoided loss as part of the definition, otherwise the market will be distorted towards mainly funding areas that need only minor interventions with minimal benefits on the biodiversity. If reduction in extinction risk is being used then this does not link to area.*



What unit of area should be used?

There are different proposals from 10m² for Terrassos projects to 1km² proposed by McKinseys. The argument for a lower area level is that it increases the number of credits issued and therefore the price per credit can be kept at a reasonable level. The argument for the 1km² level is that it prevents inflation in numbers of credits. For example, if we wanted to issue credits for 30% of Brazil's land area this would need 2.5 million credits at the 1km² level, 255 million credits at the hectare level and 256 billion credits at the 10m² level. From experience of developing projects at the hectare level, credits are priced between $5 - $10 to cover the costs of the project, which is in a similar range to those charged for carbon. At the km² level these costs would be $50 - $100 per credit and at the 400m² level these would be $0.2 - $0.4 to compete on price with hectare level issued ones. Another issue is that some sites are less than 1 km² so would result in issue of part credits.

Recommendation: *Expressing biodiversity in area terms at the hectare level seems to be the most practical unit to use.*

Should time be added to the definition for restoration projects?

One of the issues identified by McKinseys is that landowners are reluctant to tie up land for long periods. However, improving biodiversity for short periods is not helping towards achieving GBF objectives any more than allowing sequestration of carbon for one year before emitting again achieves climate objectives. There needs to be some definition of permanence. The rate of breakdown of CO_2 molecules in the atmosphere has led to the requirement of 1000 year schemes for Certified Emission Reduction (CER), but in the voluntary market, 100 years is seen as a more realistic target for permanence. Most carbon projects submitted identify a 25 – 30 year period as that covered by the carbon credit income but point to development of other activities that provide economic drivers to maintain the sequestration well beyond the 25 – 30 year period of the project. It would make sense for the biodiversity credit approach to mimic this and have a 25 – 30 year funded longevity but with either economic drivers developed to extend the protection well beyond the project period, or to include the area after restoration in one of the 30 X 30 protected areas.

Do we need to add time into the definition of the biodiversity credit? For restoration projects it is the amount of biodiversity gain over the area that is being protected that is the key issue. Time here is irrelevant and indeed if you included time in the definition for restoration projects it might encourage low rates of biodiversity improvements. For avoided loss projects, credits for a 25-year project would be awarded at 1/25th per year of the total credit difference between the submitted site and a reference site

at the start of the project. Verification exercises could be completed every five years to verify that the same level of biodiversity had been maintained and five years of verified biodiversity credits can be issued. If the level of biodiversity had declined, then the 25-year total of credits would be reduced to account for the decline and 1/25th of that reduced number issued for the preceding five years. Likewise, if the biodiversity had improved then the total number of credits for the 25-year period would be increased and 1/25th of that increased number issued for the preceding five years. Note if there was a subsequent fall in biodiversity after an increase in the first five years then the number of credits would be recalculated for the full 25-year period and any excess issued in the first five-year period reduced from the number issued in that second year period.

Verification events would be at least every five years but could be more frequent, so funders would receive batches of credits after each event which they could then average out in terms of numbers issued per year over the intervening period between verification events.

Recommendation: *Biodiversity credit projects should have a minimum of 25 years longevity and identify either how the site will be included in the 30 X 30 nationally protected areas or have developed economic drivers to ensure project permanence well beyond the 25 year minimum period.*

Do we need multiple Nature based credits to reflect different ecosystem services?

There is a whole suite of other ecosystem service credits being proposed. These include water credits, and nutrient credits associated with low fertiliser use areas. The McKinsey proposal includes others such as forest cover loss, freshwater consumption, chemical and plastic pollution as well as nutrient pollution, loss of soil quality, biodiversity loss and carbon. There are others that could also be included such as pollination habitat value, climate resilience etc. How do these relate to each other, or can they be incorporated into a single Nature credit?

One argument against a single Nature credit is that it would be very difficult to quantify each of those services for every project. Also, if you collapse all the ecosystem services into one credit that includes carbon, then it is very likely that the dominant feature of the credit will be carbon value and the others will be seen as secondary co-benefits. We have both a climate and a species loss crisis and both of these ecosystem services need quantifying and monetising.

Fortunately, many ecosystem services can be assessed using biodiversity metrics as below and all of these can be included in the basket of metrics approach:

1. Water quality is best measured using aquatic macro-invertebrate communities. Indeed, there are also good aquatic invertebrate monitoring systems for low flows.
2. Air quality can be monitored using lichen communities.
3. Soil quality can be measured from changes in soil invertebrates and/or fungal communities.
4. Pollination value can be measured directly from the abundance and species richness of pollinating species such as bees, hoverflies and flies.

When building a basket of metrics to assess biodiversity these biodiversity indicators of other ecosystem services that are likely to be impacted by the project, should be included. Note these water and air quality monitoring systems are not available in all regions of the world but where they are, they should be used.

A key issue though is to identify how different types of credits can be stacked. If you are, say, planting a natural forest on existing arable land which is part of an existing nutrient control system for which the farmer is receiving subsidies, then trying to differentiate which benefits of the new forest are related to carbon, which are biodiversity benefits, and which are a result of lowered nutrient inputs, is an insoluble problem because the benefits are interrelated. For example, an increase in breeding birds is reliant on tree and scrub growth, which in turn is benefiting carbon, whilst an increase in rarer low nutrient tolerant plants would be measured as an increase in biodiversity but it wouldn't have happened unless there was a low nutrient

strategy. The easiest way to determine whether the project has additionality on each of those services is to determine whether those benefits would have occurred if the project had not been implemented. If they would not have occurred, then the issue is one of financial viability and additionality.

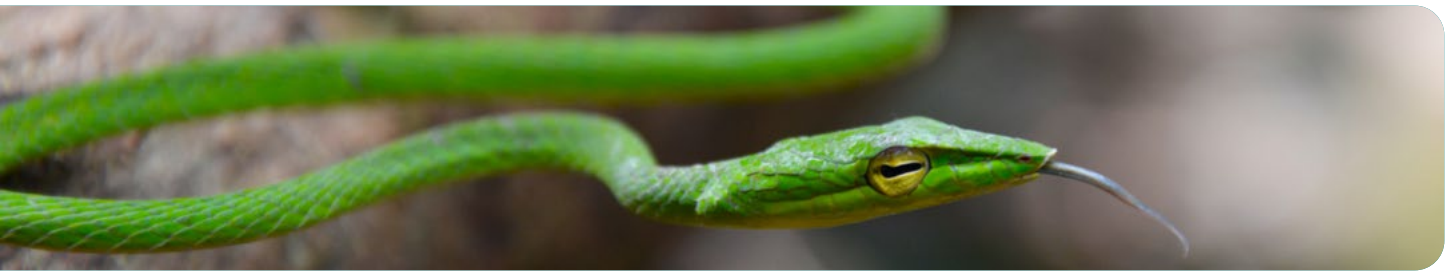
Would the project have happened if carbon and biodiversity credits plus low nutrient payments weren't stacked together? If you can run the project on just one of those payment systems, then use just that one, but in many cases all the multiple income streams are needed to fund a project.

Recommendation: *Include measurements of other ecosystem services using biodiversity criteria wherever possible and use financial viability to determine additionality when stacking different types of credits.*

Can biodiversity gain be measured indirectly by using process type approaches such as Climate Community and Biodiversity (CCB)?

A commonly used existing approach for REDD+ forest loss avoidance projects is to use a Climate Community and Biodiversity process in the design. This approach is akin to the ISO9000 quality standard, whereby companies could obtain an audited quality standard by identifying all areas of the business where quality could be improved and setting a target for improvement for each of those areas. The size of the targets or how quickly they had to be achieved was not part of the auditing process, so it was possible for companies to be the worst performing in terms of quality in a particular sector and still achieve the ISO9000 quality standard. The same criticisms apply to CCB or other process type approaches and two projects both with CCB standard approval could have massively different rates of biodiversity gain over the baseline, yet both would be awarded the same number of credits for having completed the CCB approach.

Recommendation: *Measuring biodiversity gain indirectly by awarding credits for just completing a process type approach would result in different outcomes for the same number of credits*



Can biodiversity gain be measured indirectly by quantifying threat reductions?

Instead of quantifying biodiversity directly could decreases in threats be used as a proxy for changes in biodiversity? In some cases, quantifying threat reductions could be much cheaper than quantifying the changes in taxa. The argument against using a threat reduction approach (except where this is part of a global extinction risk reduction approach), is that it is difficult to develop a method that allows comparisons of the benefits of different threat reductions (e.g. reducing pesticide usage, increasing trapping for invasive species, improving anti-hunting patrolling measures or reducing bomb fishing on a coral reef) or even different intensities of reduction in the same threat category but in different ecoregions or habitats. Let's say for example we gave 10 biodiversity credits per hectare for reducing bomb, cyanide and other types of fishing on a coral reef for a project that lasted 25 years. Presumably you would get 1/25th of the credits each year for successful elimination of all fishing effort on the reef. How would you deal with some remaining fishing effort though? A line fisher would have very little impact compared to say installation of a fish fence. What about the occasional incidence of cyanide fishing. As the fish populations grow on the protected reef the threat of illegal fishing increases, so how do you deal with a major fishing effort 10 years into the project? Do you return all the credits that have been issued to date? Also you would need to monitor 24/7 to ensure there was zero fishing effort and in this case it would be less expensive to quantify the impacts on the target taxa. In order to make threat reduction comparable between threats, you would need to have a scoring system comparing say deforestation (say 20 credits per hectare over a 25 year period) with reducing fishing effort (say 10 credits per hectare over a 25 year period). The ratios between these different threat reductions would not make sense in different cases.

Threat reduction information should be provided annually as KPI's between verification events to indicate that the project is still heading in the right direction. Issuing credits on the basis of threat reduction activities alone would lead to some strange results. Imagine we accepted methods for reducing carbon (car-pool sharing, increased patrols to reduce deforestation etc.) as units of climate change but without measuring the quantitative impact on carbon!

Note threat reduction is a key part of all biodiversity projects. The Ekos Sustainable Development Units for example are derived by calculating the costs of managing an area for say 25 years including quantifying the costs of reducing or eliminating all the threats. The reduction in threat-level is then measured on a regular basis and used as an indicator that the project is working. However, direct measurements of biodiversity also provide additional verification at regular intervals, so the success of these projects can be assessed from direct measurements of changes or avoided loss in biodiversity. Quantifying the benefit in terms of units of biodiversity change, would enable Ekos projects to be compared with other projects in terms of value for money.

Recommendation: *A quantifiable unit of biodiversity gain will need to measure the changes in biodiversity directly rather than attempting to estimate them indirectly through quantifying threat reductions.*

Can indicator species, habitat changes or threatened species be used as a measure to quantify biodiversity?

If measuring biodiversity directly is needed can this be done by using indicator species? Or threatened species? Or just looking at habitat changes?

Using single indicator species to determine the overall impact on biodiversity can result in a poor indicator of overall improvements in biodiversity. For example, one carbon project in Sumatra had increasing tiger population levels as the sole indicator of the biodiversity benefits of the project. This could be achieved by increasing anti-hunting patrols for tigers and ensuring that populations of deer and boar remained high. However, if this was a lowland rainforest you could remove most of the forested areas and the benefits to other taxa and still achieve the increase in tiger populations. Should that be seen as an overall improvement in biodiversity even though you have lost much of the forest and the species reliant on it for survival? Indicator species will change according to habitat type and finding indicator species that represent an overall improvement in all taxa is difficult or impossible in many habitats.

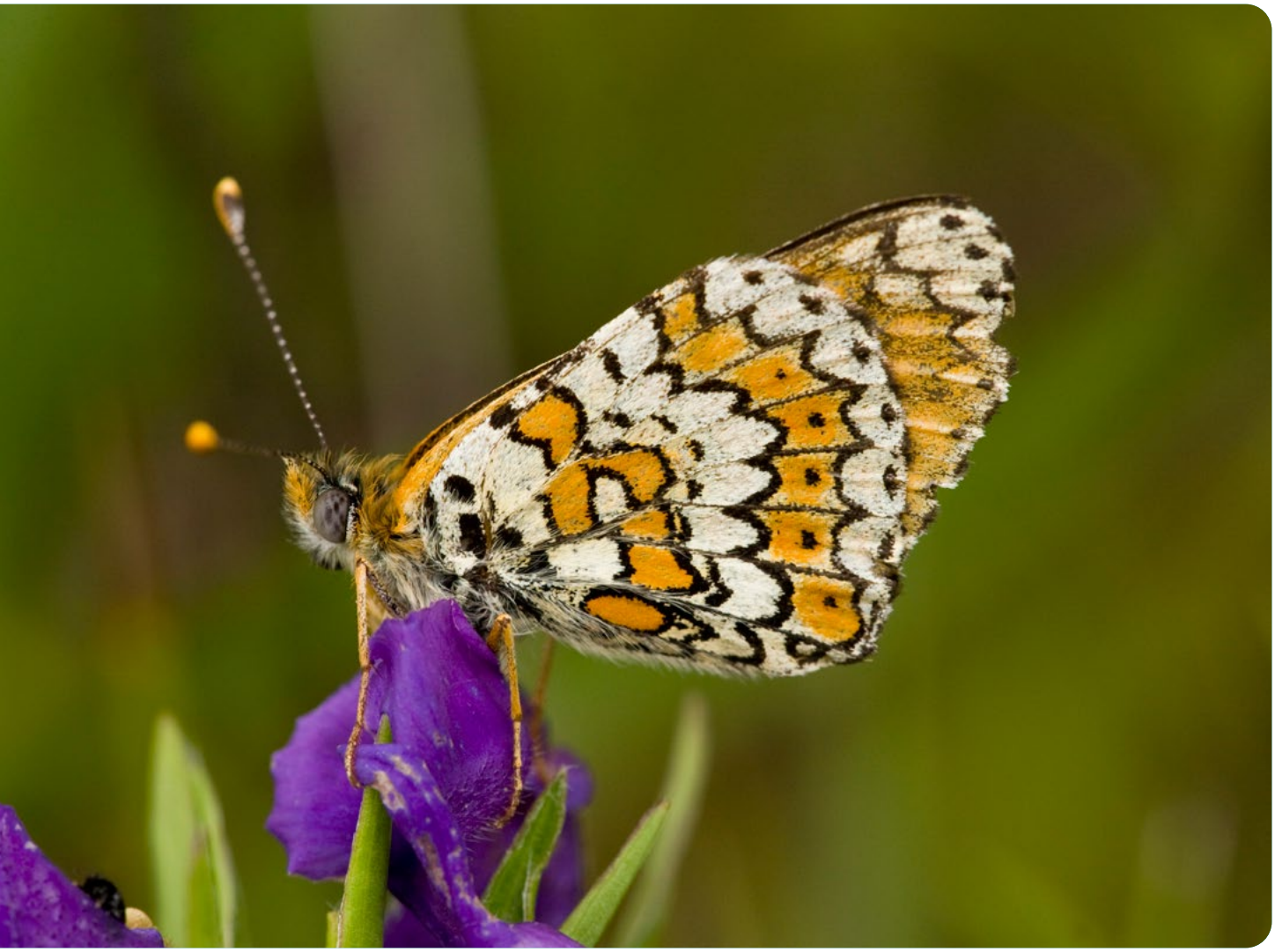
If we can't use individual indicator species, could we use habitat change as a proxy for overall improvement in a site? The difficulty here is ranking the relative importance of habitats so that you can assess that a change from habitat 1 to habitat 2 is an improvement. The UK is the only country in the world that has achieved a relative ranking of all habitats (DEFRA biodiversity metric 3.1) on a continuous scale and which, coupled with condition scores, can be used to assess a numerical value for changing from one habitat type to another.

IUCN has produced a set of guidelines to classify habitats in each country into eight categories of ecosystem risk and five criteria that provide a consistent method for assessing the risk of ecosystem collapse. These could be scored and changes from one category to another could be turned into a numerical value. Few countries so far have completed classification of their habitat values against these criteria, so it is not a system that can be applied worldwide at the moment (although it can be used in countries where this exercise has been completed). The main argument against using habitat alone is that the presence of a habitat does not imply the full range of floral and faunal species that could occur, will be there. Indeed, the author of the UK DEFRA biodiversity metric 3.1 admitted in a TV interview that when judging biodiversity impacts of projects and restoration schemes, that habitat metrics should be used only as part of a basket of metrics that include the changes to other floral and faunal taxa. A good example of this is that a recent DEFRA study comparing the biodiversity value of arable fields with an adjacent 20-year rewilded site showed that the lowest increase in biodiversity was from the habitat metric where other taxa (breeding birds, butterflies, arthropods excluding butterflies etc.) had increased significantly more than the value measured by habitat change alone.

A better method is to use all threatened species occurring in an area as a measure of biodiversity value. However, in order to do this then you would need to complete surveys on multiple taxa (e.g. fungi, higher plants, arthropods, molluscs, amphibians, fish, reptiles, birds, mammals etc.).

Completing those surveys would also give you data on the whole community composition of each of the taxa. If these data are available why not use them and present information on how the species richness weighted by importance based on threat category and their relative abundance is changing? It would be possible to screen sites for threatened species just using eDNA but this will only produce lists of the species present and little or no information on relative abundance. The oft quoted 70% decline in wildlife in recent decades is not referring to a 70% drop in species, but a 70% drop in population levels overall. Having an assessment of relative abundance or biomass changes between times should be a key part of a biodiversity measure and this would require additional measures on top of eDNA to quantify. If surveys including relative abundance are being completed for key taxa then why not use all these data to score changes in species richness, importance and abundance/biomass values for every species in the taxon?

Recommendation: *Measuring biodiversity directly by using indicator species, habitat or even changes in all threatened species has significant drawbacks as a method of assessing biodiversity value. Metrics for biodiversity value need to include complete taxa and species richness weighted by importance value according to rarity and measures of abundance/biomass.*



Is measuring biodiversity across a number of taxa too expensive and complex?

The main argument against measuring complete taxa directly is its complexity and expense, which would make it impossible for many projects to achieve.

This can be answered in three ways:

1 Biodiversity is the sum of all life on earth and refers to the idea of variation at the genetic, species and ecosystem level. Monitoring genetic diversity of all species within a target area is impractical and would be prohibitively expensive. However, monitoring relative abundance of all species within a taxon (a taxon is defined as either a functional taxon such as soil invertebrates or breeding birds, or a zoological taxon such as butterflies or reptiles) and using multiple taxa, can provide good measures of the community composition within the ecosystem being studied and can be achieved at a relatively low cost.

2 If monitoring entire taxa required dozens of specialists on the ground and identifying all captures or encounters to species level, it would be an impossible task. However there have been significant advances in MRV techniques such as eDNA and metabarcoding, sound analysis to survey birds, frogs and bats, fixed wing LIDAR drones and improved satellite imagery to monitor forest structure and automated analysis of camera trap data that allow most, if not all taxa, to be monitored using these much more rapid and inexpensive techniques.

3 There is a common misconception that a 50,000 hectare site requires 100 times more monitoring effort than a 500 hectare site in order to get the same level of precision in the estimates (i.e. same level of confidence intervals). This is not correct – the main determinant of sampling effort is habitat heterogeneity. Stratified (by habitat) random sampling in each habitat should be used and using this approach the differences in sampling effort between a very large area with a mainly uniform habitat, and a complex smaller area will be nothing like the hundred-fold difference estimated for the above example.

Recommendation: *Biodiversity can be measured for species richness with relative abundance/biomass using modern MRV techniques and covering all species in a functional or zoological taxon, relatively inexpensively. The costs per hectare for monitoring falls substantially for larger areas.*

How many taxa need to be quantified to assess overall biodiversity change?

If we are going to measure entire taxa, then how many taxa need to be quantified in order to assess overall biodiversity changes? The objective should be to measure all taxa that are included in conservation objectives for the habitats being improved for wildlife conservation.

Thus, if you are rewilding an arable farm without major areas of water then you could have the following objectives to demonstrate improvement:

1. Improved soil quality from removal of ploughing (soil invertebrates species richness and biomass)
2. Improved mix of habitats (UK DEFRA Biodiversity Metric 3.1)
3. Increased plant diversity from removal of herbicide usage (higher plant surveys)
4. Increased butterflies from removal pesticide usage (butterfly species richness and abundance)
5. Increased arthropods excluding butterflies – one of the major causes of ecosystem collapse in the UK (arthropod species richness and biomass)
6. Increased breeding birds from improved diversity of habitats (bird species richness and abundance).

If you were restoring an Indonesian reef that had been bomb and cyanide fished then you could have the following objectives and measure them using the taxa listed:

1. Removal of bomb fishing should allow rugosity to recover (3D rugosity surveys)
2. Coral cover should increase from removal of trampling and fishing activity (coral cover surveys)
3. Increased piscivorous fish from removal of fishing pressure (piscivorous fish species richness and abundance)
4. Increased herbivorous fish from removal of fishing pressure (herbivorous fish species richness and abundance)
5. Increased populations of commercially exploited macro-invertebrates (macro-invertebrate species richness and biomass).

Experience of using this approach has shown that five taxa will be sufficient.

Recommendation: *A minimum of five entire taxa (functional or zoological) should be used to quantify biodiversity restoration or avoided loss projects and the median change in the basket of metrics used to assess overall biodiversity increases or avoided loss.*

Suggested definition for a biodiversity credit

Based on the logic above the following definition of a biodiversity credit could be used: **'A unit of Voluntary Biodiversity Credit (VBC) is a 1% gain per hectare in the median value of a basket of taxa that encompass the conservation objectives for the site or a 0.001% reduction in the cumulative extinction risk scores for all species on the submitted site.'**

Note this does not specify how or what measurements are completed, so still allows innovation in the market. It does define a biodiversity credit unit in the same way as a carbon credit is quantified and would allow biodiversity credits to be traded. The term biodiversity gain is used to encompass both restoration and avoided loss projects.

Recommendation: *Using the definition of a VBC above, companies reporting on investment towards their Nature Positive targets can quantify it as having achieved an average biodiversity gain of, for example, 50% over 2000 hectares in the last year. This could be linked to global targets by identifying how much of that biodiversity gain was achieved in 30 x 30 estate sites. If the extinction risk reduction element of the definition were to be used, then the total benefit could then be expressed as a percentage reduction in the overall cumulative global or national extinction risk scores for a country. Note in many cases both methods for reporting biodiversity gain could be calculated and reported as contributions towards global and national targets.*

How could the above definition be used by tokenisation schemes?

Value Nature is proposing a scheme where a set number of tokens to encompass all ecosystem service benefits for protecting an area of land are issued at the start of the project at a price that reflects the costs of managing the whole area over a 10-year period. These tokens are sold at this base price, but the concept is that as the management proves effective and the biodiversity, carbon and other ecosystem service benefits increase in the affected area, that the price of the issued tokens increase in value enabling a secondary market. Monitoring will include assessing the effectiveness of a number of threat reduction measures (as KPI's between verification events to show that the project is heading in the right direction) as well as a number of digital monitoring techniques quantifying changes in the biodiversity and carbon (satellite analysis, camera trapping, sound analysis etc.). This approach does not need carbon or biodiversity credits to work but quantifying the carbon and biodiversity credit improvements in the site at regular intervals (from the data already being collected) would help token resellers demonstrate the value of the tokens in terms of carbon and biodiversity credit equivalence.

Acknowledgements:
Thanks are due to the many people who corresponded and debated in one on one meetings to help shape the ideas and to make the definition as inclusive as possible but without damaging the rigorousness of the approach recommended. There are too many to mention by name but the final version of this report bears little resemblance to the initial draft which is testament to how those conversations shaped the ideas.

Photos courtesy of: Aiden Burrow, Benjamin Sadd, James Matthews, Jason Suwandy, Kathleen Webster, Kevin Schafer, Malachi Isome, Matthew Norman