

Working hed: Analysis: The biodiversity footprint of Oxford University / Oxford University leads on measuring biodiversity impact

Working standfirst: Every large organisation should plot a path to net gain in biodiversity -- here's how.

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To help achieve ecological recovery worldwide, more and more multinational corporations are making commitments to biodiversity conservation^{1, 2, 3}. According to the most recent 2018 assessment, 43 of the FTSE100 companies have done so -- from the retail corporation Walmart to the insurance company Axa⁴ (see Box 1).

To deliver real gains -- in the population sizes of endangered species, say, or in the number of hectares of restored forests, grasslands or wetlands -- large organisations need to determine which of their activities have the greatest impacts on biodiversity⁵. And they need to disclose and mitigate those impacts. (By 'large organizations', we mean formal entities composed of hundreds of people or more, carrying out activities towards a certain purpose, whether in the public, private or non-profit sector.)

Currently, methods for doing this are lacking (see Box 1).

Where quantitative analyses have been done, the metrics used to quantify impacts range from the proportion of local species that would be lost as a result of an activity, to things like hectares of habitat, or the amount of sustainably sourced paper, fish or palm oil⁴. But the choice of metric can radically alter the results of an impact assessment, so it is difficult to compare organisations. Likewise, very few analyses consider the impacts of activities that are not under the direct control of the organization -- such as those associated with supply chains⁶.

As a proof of principle, we conducted a comprehensive assessment of biodiversity losses associated with activities at the University of Oxford, UK. We used purchasing data, travel bookings, utility bills and other data from the 2018-19 and 2019-20 academic years. The 60 activities we assessed included the day-to-day running of buildings and transport services, travel (including air travel) for students and researchers, the construction of new laboratories and other buildings, the consumption of food and beverages at restaurants and cafeterias, and the use of medical supplies and other materials in research laboratories.

Our aim was to demonstrate what it would take for a large organization like Oxford University to bring about a net gain in biodiversity -- meaning that thanks to its actions, the world's biodiversity is left in a better state than it was before. As part of our analysis, we assessed how the University's various activities and operations impact greenhouse gas emissions -- and how those emissions in turn affect biodiversity by driving climate change.

We are confident that the approach we've developed for Oxford could be applied more broadly. Indeed, we hope that such a well-known institution as Oxford University disclosing a full assessment of its biodiversity footprint will offer powerful inspiration for others. (All seven of us have a current or prior affiliation with the University of Oxford.)

What we did

The University of Oxford launched an ambitious environmental sustainability strategy in March 2021 with two main goals: biodiversity net gain by 2035, and net zero carbon by 2035 (meaning the University removes as much carbon from the atmosphere as it adds).

To understand how challenging these goals might be to fulfil, we assessed the environmental impacts of the University's various activities.

Our assessment covered all activities to do with research, education and operations undertaken during an academic year for staff and students (see graphic). (The **UNIVERSITY TRANSPORT FLEET, DEPARTMENTAL FOOD CONSUMPTION, UTILITIES CONSUMPTION, WASTE DISPOSAL, AND OPERATIONAL SUPPLY CHAIN E.G. PAPER AND IT USE ALL FALL** under 'operations'.)

As a first step, we defined a conceptual framework to systematically categorize the environmental impacts of University activities.

We grouped activities (see Box 2) in research, education and operations according to whether they involved five features: travel; food; the built environment (university buildings); the natural environment (any green space or land owned by the university, including managed parks and gardens); and resource use and waste. Each of these categories are associated with five general environmental impacts: greenhouse gas emissions; land use; the use of water; water pollution; and air pollution.

To further categorize the environmental impacts of University activities, we assigned each activity to one of two groups: those under direct University control or influence (through staff and key contractors); and those that the University can influence only indirectly (through students and supply chains). Students buying tuna sandwiches from a University-owned café we deemed 'under direct control', for instance, because the University could decide to serve only vegetarian food. However, the University can influence only indirectly what happens up the supply chain, before materials are used in a research laboratory.

Using this organizational framework, we worked with the administration departments to obtain travel bookings for staff and students; electricity bills; water bills; purchasing records (for goods and services, and for the materials used in construction projects); and so on.

Next, we needed to convert this information on activities into general environmental impacts. So we converted all the activities data into estimates of what we call mid-point environmental impacts (amount of carbon dioxide emitted, land used, water used, air or water pollutants produced) using various tools. Exiobase 3 is the most extensive database currently available on international supply chain impacts worldwide⁷. It shows, for instance, that the University spending around US\$ 3.5 million in 2019-20 on paper and paper products contributed to atmospheric acidification through the release of 2,448KG SO₂ equivalent. Likewise, the UK Higher Education Supply Chain Emissions Tool (HESCET) uses the amount the University spends on goods and services to estimate greenhouse gas emissions. (Spending around US\$ 23 million on personal computers, printers and calculators in 2019-20 produced an estimated 20,105.6 tonnes of CO₂ equivalent.)

Then we needed to estimate the extent of biodiversity loss associated with this wide range of broad environmental impacts. So we converted these mid-point environmental impacts into 'end-point impacts' specifically concerned with biodiversity. To do this, we used an established conversion tool called ReCiPe⁸. The output metric ultimately linked to each activity was the proportion of local species that would be lost as a result of that activity relative to the number that exists currently. (See Supplementary Information for all results and conversion factors.)

Caveats

We refined our methods slightly when analysing data from the second academic year we looked at (2019-20). This, combined with the disruption caused by the COVID-19 pandemic, makes it difficult to compare years. So for simplicity, here we report our results only from the 2019-20 academic year.

The biodiversity metric we obtain using ReCiPe is based on strong evidence; the conversion tool is derived from the results of hundreds of studies of the impacts of human pressures on biodiversity⁸. But in general, we weren't able to factor in fine-level variables, such as whether the beef in the steaks provided by an Oxford University-owned restaurant is sourced from a UK or Brazilian farm. As such, our approach is best seen as a way to evaluate relative impacts, rather than as an indicator of precise absolute impacts.

Even putting this difficulty aside, it is hard to compare the University of Oxford's impact on biodiversity with that of other similarly sized organizations. As yet, no other organization has comprehensively evaluated and disclosed its impact on biodiversity, and then had their assessment independently validated. (Ecologists and other stakeholders at the University of

Jyväskylä in Finland have begun to explore the impacts of the University's activities on biodiversity using a similar approach to the one we describe.) [[link: https://jyx.jyu.fi/handle/123456789/75182](https://jyx.jyu.fi/handle/123456789/75182)].

Using the greenhouse gas emissions metric, however, we can compare the impacts of Oxford University on emissions (which are related to its impacts on biodiversity) with those of other comparably sized organizations.

What we found

The absolute size of the University's greenhouse gas footprint is astonishingly large – comparable to that of the Eastern Caribbean island nation Saint Lucia. It is two orders of magnitude smaller than Microsoft's publicly disclosed greenhouse gas footprint, but one order of magnitude larger than that of the London Stock Exchange.

Perhaps the most striking finding in our assessment of impacts specifically on biodiversity is that most of the harms are tied to University activities that are not under the organization's direct control. In fact, the activities with the five biggest impacts on biodiversity are (from biggest to smallest) the supply chain for research activities, the supply chain for the day-to-day running of University buildings besides research laboratories, food consumption, electricity consumption, and the supply chain for the construction of new buildings. All these activities are associated with resource use and waste, food, and the built environment.

In short, supplies of laboratory equipment can have far greater impacts on biodiversity overall than transport -- and even the day-to-day running or construction of buildings. (Personal protective equipment, for example, requires the extraction and industrial processing of hydrocarbons, often from areas that are rich in biodiversity.)

This observation is in line with the results of a handful of studies, which suggest that supply chains, not transport or the day-to-day running of buildings are the main contributors to greenhouse gas emissions for universities^{9, 10, 11, 12}. It also aligns with the results of assessments made by the fashion giant Kering since 2012, using their Environmental Profit & Loss (EP&L) account – a tool designed to quantify the environmental impacts of the company's activities. These have similarly revealed that Kering's procuring of commodities, such as leather, wool and metals, has far more impact on greenhouse gas emissions, and particularly on land use, than the day-to-day running of its factories and offices¹³.

Yet the sustainability strategies of large organizations typically focus not on supply chains. but on recycling, or on reducing the numbers of flights people take or the amount of electricity they use^{14, 15, 16, 17}.

Another important finding is the scale of intervention needed. Restoring the University's owned land (around 1,000 hectares) to native woodland, or some other more natural habitat, would make little difference when it comes to compensating for the impacts on biodiversity

that result from just one year of activity at Oxford University. The University colleges own far more land than the University itself – around 50,000 hectares -- but we excluded these from our analysis because they are independent legal entities that manage sustainability issues separately (see Box 2.)

Oxford's options

So how could Oxford University reverse the biodiversity losses stemming from its activities and operations?

Here we consider three options. The University could pursue its current environmental sustainability strategy. This entails (among other steps) setting quantitative targets to reduce flights, limiting the use of all single-use products, making University-catered food vegetarian by default, and achieving 20% net gain for biodiversity in new construction projects. Alternatively, it could focus more heavily on preventing harms to biodiversity; we model a scenario where all staff flights are prevented, where all use of paper and any further construction is stopped, and where the purchasing of laboratory materials is halved. Or the University could focus more heavily on compensating for the impacts that its activities and operations have on the planet by taking steps to increase biodiversity in other places.

Using the 2018-19 academic year results (selected because of the COVID-19 pandemic making 2019-20 so unusual), we estimated how far these different mitigation strategies might take the University towards biodiversity net gain.

Our analysis indicates that the set of prevention measures proposed under the University's current environmental sustainability strategy get the institution about one third of the way towards net gain. It also indicates that focusing primarily on the prevention of impacts is operationally unfeasible. The activities that have most impact on biodiversity, such as the purchasing of consumables for laboratory work, are central to the existence of the University and cannot simply stop.

To achieve net gain, preventative measures, such as reducing flights and paper use, will have to be accompanied by additional and extensive actions to compensate for the University's remaining impacts on biodiversity.

Such actions could include investing in re-forestation, in wetland restoration, in sustainable land-management programmes, and in the prevention of habitat loss caused by independent parties. Those directing the Oyu Tolgoi mining project in Mongolia, for example, are seeking to achieve biodiversity net gain by spending around 0.6% of the total amount spent on the project on various actions, such as sustainable grazing practices, that benefit biodiversity¹⁸. The Ambatovy metals mine in Madagascar is similarly on course to offset its impacts on the biodiverse eastern rainforests by preventing unrelated deforestation of those same habitats caused principally by shifting small-scale agriculture¹⁹.

Achieving true biodiversity net gain will clearly require substantial biodiversity offsetting that does not necessarily contribute to the University's reductions in greenhouse gas emissions. But whatever mix of approaches it pursues, Oxford University should strive for win-wins on both biodiversity and climate. *[note to subeditor: pls insert inline link: <https://www.nature.com/articles/d41586-021-01241-2>]*

All sorts of actions can increase biodiversity and reduce greenhouse-gas emissions simultaneously. For example, the restoration of mangroves in Bangladesh (starting in 2004) increased populations of wintering water birds 20-fold in just three years. And these restored mangroves can absorb four times more carbon than land-based forests²⁰. But in other cases, there may be trade-offs. The construction of wind turbines and solar photovoltaics for the production of renewable energy, for instance, requires extensive metals mining in places that may be rich in biodiversity²¹.

Net gain for other large organisations

Our calculations are likely comparable to what would be found for other universities. In our analysis, we do not include the impacts of colleges. But because similar kinds of activities go on within colleges as within the rest of the University, the inclusion of colleges -- or halls of residence in other universities -- is unlikely to qualitatively change our main findings. In fact, because of Oxford University colleges' unusually large land holdings, their inclusion would arguably result in an assessment that doesn't so easily compare with that of other universities.

Crucially, though, the analytical framework we have developed here can be applied to a wide range of large organisations – whether they be universities, multinational corporations or government institutions.

Governments, intergovernmental organizations and multinational corporations are increasingly recognising that it will not be enough to simply slow the loss of the world's biodiversity. Damaged habitats and depleted natural resources must be restored to prevent the collapse of ecosystems.

Last year, the United Nations called for the urgent revival of nature in farmlands, forests and other ecosystems, declaring 2021-2030 to be the decade of ecosystem restoration. Next month, at a meeting in Kunming, China, it is hoped that 196 nations will agree to the Post-2020 Global Biodiversity Framework of the Convention on biological diversity. Among the goals listed in the draft document are: 'a net gain in the area, connectivity and integrity of natural systems of at least 5%'²².

We urge all large organisations, academic or otherwise, to commit to net gain biodiversity strategies – and to adopt formalized approaches that quantify current impacts and allow transparent tracking of progress over time. Otherwise, the degree of worldwide recovery of

natural resources increasingly recognised as critical for resilient societies to function will not happen.

A key challenge in doing this is the lack of traceability for commodities.

Our assessment of Oxford University, along with those of others, have revealed that large organisations frequently don't know which country their commodities come from (be they cotton, flour, or cement) -- let alone which supplier, or what kinds of biodiversity are being affected as a result of the company purchasing them.

According to its most recent (2020) report, for example, even a sector leader such as the fashion giant Kering could trace the source of only about three quarters of its cotton. Supply chains for other commodities, such as sand, are even more opaque²³.

Encouragingly, various initiatives and tools, such as TRASE, are being developed to try to provide more transparency about environmental impacts across supply chains. *[note to subeditor: pls insert inline link: <https://www.trase.earth/>]*

A related challenge, covered extensively elsewhere^{24, 25}, is how to ensure that biodiversity offsets are effectively and appropriately implemented, such that they lead to truly 'additional' conservation outcomes.

Currently, there are uncertainties around how long it takes for a restored forest to start delivering biodiversity gains, whether promises to offset harms to biodiversity are actually met, what level of biodiversity gain is delivered by the restoration of a particular habitat, and so on. Take the previously mentioned Ambatovy metals mine in Madagascar. Those directing the project began protecting areas of eastern rainforest in 2009 to offset the impacts of deforestation directly caused by the mine; forest gains are estimated to balance losses sometime between 2018 and 2033¹⁹.

Despite such challenges, however, we believe that a commitment to full transparency, and to improving data collection over time, will enable organisations to compare performance and drive change – both within their own operations, and throughout supply chains.

Time is too short to let the perfect be the enemy of the good, or to claim that biodiversity net gain is too hard to achieve because there is no universal biodiversity metric.

Box 1

Hed: Promises are hard to keep

Intro text: A lack of consensus on methods and metrics means companies are struggling to clearly define – and so deliver on -- commitments relating to biodiversity.

So far, most of the studies of the environmental impacts of organizations, such as multinational corporations and universities, have focussed on greenhouse gas emissions.

The G7 endorsed the new Taskforce for Nature-related Financial Disclosures (TNFD) only last year. This initiative builds on a similar approach used for climate change -- the Taskforce on Climate-Related Financial Disclosures or TCFD. The TNFD aims to guide organizations on how to disclose environmental harms tied to their activities, but it is still being developed.

The number of corporations making commitments to achieve ‘net gain’ or ‘no net loss’ outcomes in relation to biodiversity has steadily risen over the past two decades³. But some of these promises are subsequently retracted. In 2016, for example, the mining corporation Rio Tinto, dropped what had been an agenda-setting ‘net positive impact’ biodiversity commitment (originally made in 2006), reportedly to focus on minimizing impacts³.

Many other commitments that have been made are not quantitative. As of 2018, only 5 of the 43 FTSE100 companies that had made biodiversity-related commitments had made SMART ones -- meaning specific, measurable, ambitious, realistic and time-bound⁴.

And when quantitative analyses have been done, they tend to be of limited use, largely because of inconsistencies in the biodiversity metrics used, and limitations in the scope of the assessment made. Disclosure of results is also limited.

Box 2

Hed: What we left out

Intro text: Other organizations could assess different types of impacts on biodiversity.

Our analysis included most upstream impacts -- meaning those resulting from the consumption of goods and services created outside of the University, such as food or medical supplies. We excluded the downstream impacts of research and educational activities, such as those of a discovery in gene-editing or in chemistry, on the grounds that it would be impossible to comprehensively account for all the environmental impacts of knowledge generation. Also not included in our analysis were the University’s 39 colleges, 6 permanent private halls, and 260 commercial buildings. These are independent legal entities that manage sustainability issues separately.

Other analyses in different sectors may well be able to include downstream impacts. The impacts of discarded plastic bottles could be included for a soft-drinks company, say, or those of discarded clothes for a clothing manufacturer.

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Metadata

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