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# The Challenges of Assessing the Effectiveness of Biodiversity-Related Development Aid

Katharina M. K. Stepping[1] and Karen S. Meijer[2,3]

## Abstract

Official Development Assistance is a major funding source for biodiversity conservation in developing countries, and it is therefore important to understand the effectiveness of biodiversity aid. However, three challenges hamper the analysis of how effectively biodiversity-related development aid (biodiversity aid) contributes to the conservation of biodiversity and its sustainable use. First, few indicators measure biodiversity aspects at country level in a consistent and comparable way. Second, biodiversity aid reporting methods do not reveal the exact funding amount for projects' biodiversity component. Third, changes in biodiversity status are empirically and conceptually difficult to attribute to aid activities. Based on a theoretical elaboration of these challenges, we argue that for a better assessment of how biodiversity aid contributes to conserving biodiversity and to reducing biodiversity loss, three improvements are required: a more frequent and more consistent assessment of the biodiversity status across countries, more exact quantification of biodiversity aid, and a more detailed understanding about biodiversity loss and the role biodiversity aid plays. These improvements will allow for more reliable aid-effectiveness analyses, which will, in turn, enable better informed aid-allocation decisions to be made.

## Keywords

aid, effectiveness, biodiversity, indicators, developing countries

## Introduction

Although of crucial importance for human life on Earth, biodiversity[1] continues to be lost at an alarming rate (Secretariat of the Convention on Biological Diversity [SCBD], 2014; World Wide Fund [WWF], 2016). Many areas with high or even exceptional levels of biodiversity are found in developing countries, yet are often threatened by serious levels of habitat loss (Conservation International, 2007; Myers, 1988). These countries face at least two challenges in their efforts to reduce biodiversity loss. First, exploitation and conversion of ecosystems are often considered acceptable in pursuit of economic development. Second, neither the available funds nor technical, institutional, and personnel capacities are sufficient to implement measures for reducing biodiversity loss and conserving biodiversity.

Several biodiversity-related multilateral agreements have increased awareness and funding, both nationally and internationally. The Convention on Biological Diversity (CBD) adopted in Rio de Janeiro, Brazil in 1992, officially recognized the importance of biodiversity per se and of providing financial resources for its conservation. According to the internationally binding framework, the parties to the convention are required to provide financial support to jointly reduce, and ultimately halt, biodiversity loss. Halting biodiversity loss is also central to the United Nations Sustainable Development Goals (SDGs) and at the heart of SDG 15 (United Nations, 2015). The Global Environment Facility (GEF) serves as a financial mechanism for the

[1]Federal Ministry for Economic Cooperation and Development, Bonn, Germany
[2]Deltares, Delft, the Netherlands
[3]Copernicus Institute of Sustainable Development, Utrecht University, the Netherlands

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**Corresponding Author:**
Karen S. Meijer, Deltares, Boussinesqweg 1, 2629 HV Delft, the Netherlands.
Email: karen.meijer@deltares.nl

CBD. Donor countries report their international financial support for biodiversity through both multilateral funds such as the GEF and through bilateral channels to the Organisation for Economic Co-operation and Development (OECD), flagged by the biodiversity Rio marker. Total bilateral biodiversity-related development aid (hereafter biodiversity aid) commitments by members of the OECD's Development Assistance Committee (DAC) increased over the past decade, growing from US$3.7 billion per year in 2005–2007 to US$5.6 billion per year on average in 2011–2013 (Drutschinin, Casado-Asensio, Corfee-Morlot, & Roe, 2015). While bilateral biodiversity aid is systematically reported by OECD DAC members, multilateral flows for biodiversity are not yet comprehensively tracked (Drutschinin & Ockenden, 2015), yet are estimated to be twice as high as bilateral flows (Miller, 2014). Official Development Assistance (ODA) is still a major funding source for biodiversity protection in developing countries (Hein, Miller, & De Groot, 2013) and is estimated to be the most significant source for biodiversity finance in many low- and lower-middle-income countries (Waldron et al., 2013). Beyond aid, ways are sought to replace traditional ODA with other means, such as environmental fiscal reform or payments for ecosystem services, collectively referred to as "innovative financial mechanisms" (OECD, 2013, p. 15). With substantial amounts of aid going to biodiversity protection, it is important to understand how effective these aid flows are. Although decisions on the allocation of biodiversity aid could be made solely based on information on where biodiversity losses, and thus the need for biodiversity aid, are highest, we believe that to sustain efforts to reduce biodiversity loss in the long term, it is important to give insight into its effectiveness. This can be done at various scales: from detailed project-level assessments to an overall link between global spending and global biodiversity change. Here, we explore the possibilities for a global scale assessment at the resolution of countries. Spending of biodiversity-related development aid, similar to aid for other sectors, is based on decisions taken by sovereign donor countries, in the best case guided by aggregate information at national level about biodiversity loss (see Waldron et al., 2017 for a similar argument). Waldron et al. (2017) find a positive relationship between conservation spending and biodiversity impact: In 109 countries, biodiversity loss was reduced by a median average of 29% per country between 1996 and 2008. Because this study considers total conservation spending, including from domestic sources, it cannot be used to assess the effectiveness of international biodiversity aid directly. Looking more specifically at research on biodiversity aid, we find studies that dealt with aid-allocation patterns (Hicks, Parks, Roberts, & Tierney, 2008; Miller, 2014; Miller, Agrawal, & Roberts, 2013).

We also find that most empirical aid-effectiveness studies focus on the effect of foreign aid on economic growth, while only a limited number of studies analyze sectoral aid—for example, see Wilson (2011) and Dietrich (2011) for health, and Dreher, Nunnenkamp, and Thiele (2008) for education. A related yet separate strand of literature, with a strong influence from natural scientists, focuses on the particular challenges presented by impact evaluations of ecosystem services. For example, Ferraro et al. (2015) discuss, inter alia, the problems of measuring impacts with imperfect proxies for ecosystem services, and Coad et al. (2015) discuss the limitations of data on protected area management interventions for impact evaluations.

Effectiveness measures the extent to which a development cooperation activity achieves (or is likely to achieve) its objectives (OECD, 2012a). In any aid-effectiveness study, the aid activity needs to be linked at least to a measureable outcome in the targeted aid sector, but each effectiveness study faces sector-specific challenges—for example, see Martínez Álvarez and Acharya (2012) for health and Michaelowa and Weber (2008) for education. In the case of biodiversity, the assessment of the effectiveness of biodiversity aid is faced with several methodological and practical challenges that are not exclusive to, but whose scale and interaction is relatively unique to, the field of biodiversity conservation (Drutschinin et al., 2015).

Most studies that focus on biodiversity and do assess effectiveness of aid tend to focus on specific projects or specific donors, as remarked by Miller (2014). Dublin, Volonte, and Brann (2004), for example, evaluated 604 projects in the GEF's Biodiversity Program. The evaluation was largely based on reports by the projects under this program. Because projects did not comprehensively report using comparable quantitative indicators, the possibility of a quantitative assessment was limited. For example, project-specific indicators such as the number of sea turtles were used for assessment. While they are important for project evaluation, they cannot easily be upscaled for a global comparative assessment. The CBD itself monitors global biodiversity through regular Global Biodiversity Outlooks but does not discuss the effectiveness of particular measures or financing mechanisms. OECD (2013) and Parker et al. (2012) discuss finance for biodiversity but do not elaborate on its effectiveness, and Drutschinin and Ockenden (2015) emphasize the need for biodiversity aid to be effective but do not assess its effectiveness. In conclusion, there seem to be no studies that have looked into the effectiveness of biodiversity aid at a global scale nor from the perspective of a country comparison.

In this article, we discuss three challenges for the assessment of the effectiveness of biodiversity aid at a global scale at country resolution: first, to "measure biodiversity status and trends; second, to quantify the amount of biodiversity aid; and, third, to link biodiversity aid and biodiversity status. We conclude that with current ODA and biodiversity data, despite recent developments, it is still very difficult to assess the effectiveness of biodiversity ODA at country level, which may be used by decision-makers as an argument against further political and financial commitments. To overcome this threat to future international efforts for biodiversity protection, we end by proposing three changes.

## Challenge 1: Measuring Biodiversity Status and Trends

The quantification and the measurement of biodiversity status is part and parcel of any attempt to assess the effectiveness of biodiversity aid. But how to measure biodiversity? We have an increased, yet still limited, understanding of biodiversity as well as of the relationship between biodiversity and ecosystem processes, but, ultimately, biodiversity is a ‘‘fundamentally multidimensional concept’’ (Purvis & Hector, 2000, p. 212). It is ‘‘the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems’’ (United Nations, 1992, p. 3).[2]

Any attempt to express biological diversity in a single number will inevitably lose information (Purvis & Hector, 2000). The interdependencies of multiple ecosystem services and biodiversity further complicate matters: Although strongly related, a project focus on ecosystem services does not necessarily benefit biodiversity or vice versa. Therefore, projects based on an ecosystem service approach should monitor whether they also protect biodiversity; conversely, schemes for biodiversity conservation should quantify how they affect ecosystem services (Science for Environment Policy, 2015). Various existing indicators are related to biodiversity, as discussed later, but ‘‘no single, comprehensive metric’’ exists to monitor and assess the state of biodiversity (OECD, 2012b, p. 162). Through the Biodiversity Indicators Partnership, the CBD itself is actively identifying and developing indicators to monitor progress toward their Strategic Plan and the Aichi Biodiversity Targets. At present, the CBD recognizes ‘‘the gaps that exist in the current suite of indicators for monitoring progress towards the Strategic Plan for Biodiversity’’ (United Nations Environmental Programme & Convention on Biological Diversity, 2015, p. 2). The deficiencies of biodiversity data sets that limit or impede the assessment of trends in biodiversity status at various spatial scales to monitor achievement of CBD objectives was already pointed out by Collen, Ram, Zamin, and McRae (2008).

To identify measurable indicators, it is useful to consider the three levels of effectiveness commonly distinguished in effectiveness literature: output, outcome, and impact level (Underdal, 2002). The output level refers to the measures taken; for biodiversity aid activities, this could refer to the establishment of a protected area. The outcome level relates to changes in behavior, such as a reduction in poaching due to the establishment of the protected area, while the impact level describes the desired end result, here the conserved or improved biodiversity status or a reduced loss of biodiversity. This impact level is what we are primarily interested in when assessing the effectiveness of biodiversity aid. Biggs, Scholes, Ten Brink, and Vackár (2007) distinguish three types of biodiversity indicators at the impact level: (a) the number of different species (species-based indicators), (b) the size/health of populations (abundance-based indicators), and (c) indicators that give an overall measure of the intactness of an ecosystem (integrity indicators). They point out that whereas species-based indicators and integrity indicators may come closest to the definition of biodiversity, abundance-based indicators give more insight into the health of populations and whether they are under threat. Integrity indicators such as the Natural Capital Index and Biodiversity Intactness Index (see Table 1) provide a holistic measure of biodiversity, but these indicators seem to be assessed infrequently for a few countries only—the Biodiversity Intactness Index is assessed for Southern Africa (see Scholes & Biggs, 2005), while the Natural Capital Index is assessed for Hungary (see Czúcz, Molnár, Horváth, & Botta-Dukát, 2008). Other indicators concern only specific species (groups) and are often assessed at regional or global level. For example, the Living Planet Index (WWF, 2016), an abundance-based indicator, provides an aggregate index at the global level that combines data on several species, all vertebrates. Also, the Red List Index (International Union for Conservation of Nature [IUCN], 2014) provides trends for four groups of species at the global level: amphibians, birds, corals, and mammals. The underlying data provide information at a higher resolution, which could in principle be aggregated to country levels, yet is limited to specific points in time: Ceballos, Ehrlich, and Dirzo (2017) showed global maps of number of species richness and of decreasing species, and percentage of decreasing species in relation to total species richness in a grid at 100 km × 100 km resolution, comparing the current distribution from IUCN with the historical distribution from specialized literature. By distributing IUCN Red List data on birds and mammals over all countries in which the species is found, Waldron et al. (2017) developed biodiversity decline scores at country level. The Marine Trophic Index (Sea Around Us, 2015) gives an indication of the composition of marine biodiversity by analyzing species

**Table 1.** Spatial and Temporal Resolution and Coverage of Selected Indicators of Biodiversity Status.

| | | Spatial | | Temporal | | |
|---|---|---|---|---|---|---|
| Indicator | Description | Unit | Coverage | Unit | Coverage | Ecosystem component |
| Impact indicators | | | | | | |
| Natural Capital Index[a] | Changes in biodiversity as combination of ecosystem area and quality | Country | A few countries | Incidental assessment | | Entire ecosystem, depending on data availability |
| Biodiversity Intactness Index[b] | Average abundance of a large and diverse set of organisms in a given geographical area, relative to their reference populations | Region | A few countries | Incidental assessment | | Entire ecosystem, depending on data availability |
| Living Planet Index[c] | Average annual rate of change for species populations | One global value | | Annual | 1970–2012 | Vertebrate species |
| Red List Index[d] | Extinction risk of mammals, birds, amphibians, and corals | One global value | | Varies across species groups, most frequent for birds (every 4–6 years) | 1980–2008[e] | Birds, mammals, amphibians, corals |
| Marine Trophic Index[f] | Shift in fishing catch from top predators to lower trophic levels | Country | EEZ of all coastal countries[g] | Annual | 1950–2010 | Fish (various species) |
| Waterbird Index[h] | Trends in waterbirds based on the international waterbird census | Supracontinental regions | Three regions covering the globe | 10-year period | 1976–1985<br>1986–1995<br>1996–2005 | Waterbirds |
| Outcome indicators | | | | | | |
| Nitrogen deposition[i] | Annual reactive N deposited | Unclear | Unclear | Unclear | 1850–2005[f] | General |
| Invasive Alien Species[i] | No. of alien species in Europe | Region | Region | Frequency unknown | 1970–2007[f] | Mediterranean marine, mammal, and freshwater[f] |
| Forest extent[j] | Forest area within a country (% of land area) | Country | All countries | 5-year period | 1990–2012 | Forests |
| Exploitation of fish stocks[k] | Fish stocks—% overexploited, fully exploited, or depleted | Country | EEZ of all coastal countries** | Every other year | 2012–2014 | Fish |
| Output indicators | | | | | | |
| Terrestrial protected area[j] | Terrestrial protected area as % of land area within a country | Country | All countries | Annual | 1990–2012 | Terrestrial ecosystems |
| Marine protected areas[j] | Marine protected area as % of territorial waters | Country | Most (157) countries with a coastline | Annual | 1990–2012 | Marine ecosystems |

*Note*. EEZ = exclusive economic zone.
[a]*Source*. Czúcz et al. (2008).
[b]*Source*. Scholes and Biggs (2005).
[c]*Source*. WWF (2016).
[d]*Source*. IUCN (2014).
[e]1980–2004 amphibians, 1988–2012 birds, 1996–2008 mammals, 1996–2008 corals.
[f]*Source*. Sea Around Us (2015).
[g]Area within 200 nautical miles from the coast.
[h]*Source*. Wetlands International (2010).
[i]*Source*. Butchart et al. (2010).
[j]*Source*. World Bank (2014).
[k]*Source*. Yale Center for Environmental Law & Policy/Center for International Earth Science Information Network/World Economic Forum (2014).

included in fish catches. The Waterbird Index (Wetlands International, 2010) looks at the abundance of populations of various birds, but with limited global resolution. Available indicators at impact level are therefore either comprehensive aggregate indices with limited global coverage or present a single global aggregate value for a limited set of species. The aggregation at global level makes sense from an ecosystem and biodiversity perspective because ecosystems extend, and many species migrate, beyond national boundaries. But, while the country level may not be the best spatial resolution to assess the status of biodiversity globally, it is the logical unit to understand the effectiveness of aid.

In the light of the limitations of biodiversity indicators at impact level, biodiversity-related indicators at the outcome level can be considered in addition. Indicators for direct drivers of biodiversity loss, such as overexploitation or forest conversion, can be used as proxies for biodiversity. It is at this outcome level that biodiversity aid seeks to induce behavioral change by promoting sustainable use and reducing pollution, overexploitation (e.g., of fish), or conversion of ecosystems (e.g., through deforestation). At this level, more data at country level are available, although many of these indicators present only one facet of the driver—for example, nitrogen deposition is only one type of pollution, and deforestation is one way to convert land. As an alternative to impact and outcome indicators, indicators at the output level, referring to the interventions made, can be used to assess aid effectiveness. For example, the extent of terrestrial and marine protected areas (World Bank, 2014) is often used as indicator. The advantage of output vis-à-vis outcome level indicators is that output level indicators are more holistic, as the protected area helps protect entire ecosystems and their biodiversity. Yet, an argument against using protected area extent as a biodiversity indicator is that a lot of biodiversity is (also) available outside protected areas. Moreover, Nolte and Agrawal (2013) found output indicators to be inadequate measures of nature conservation.

The lack of indicators (and of alternatives) that quantify changes in the biodiversity status over time, and in particular at the country level, is a serious limitation to any effectiveness study of biodiversity aid. The lack is also troublesome beyond the conceptual concerns: Deliberately selecting the adequate indicator in an aid-effectiveness study is crucial because, first, the effect of aid may be distinct for any particular indicator and, second, the indicator's pattern of missing data may bias regression results (Breitwieser & Wick, 2016).

## Challenge 2: Quantifying Biodiversity Aid

The central source of information for international financial flows for biodiversity from donors (developed countries) to recipients (developing countries) is ODA as reported by OECD-DAC data.[3] Donor countries are committed to supporting developing countries to meet the targets of the so-called Rio Conventions on Biodiversity, Climate Change, and Desertification. The biodiversity Rio marker is used to monitor, through its Creditor Reporting System (CRS), biodiversity aid that targets at least one objective of the biodiversity Rio Convention: the conservation of biodiversity, sustainable use of its components (ecosystems, species or genetic resources), or fair and equitable sharing of the benefits of the utilization of genetic resources. An activity can be marked with the biodiversity Rio marker (OECD, 2015a), if it contributes (a) to the protection of or for enhancing ecosystems, species or genetic resources through in situ or ex situ conservation, or remedying existing environmental damage; (b) integration of biodiversity and ecosystem services concerns within recipient countries' development objectives and economic decision-making, through institution building, capacity development, strengthening the regulatory and policy framework, or research; or (c) developing countries' efforts to meet their obligations under the Convention. The biodiversity Rio markers were established in 1998, yet their usage for reporting became mandatory for DAC members from 2007 flows (OECD, 2015a). It is important to keep in mind that the biodiversity Rio marker only applies to bilateral ODA. Bilateral figures include earmarked contributions channeled through the multilateral system but do not capture contributions to multilateral agencies such as the GEF and the World Bank (OECD, 2015a). A related data source is the AidData database. The database builds upon the OECD's CRS data, including the Rio markers but includes a broader range of donors, finance flows, and projects (Tierney et al., 2011).[4] While it is a valuable source for researchers, it is uncertain whether these data have a similar acceptability by public donors as the officially reported OECD data.

The OECD distinguishes two types of biodiversity aid: (a) activities marked as having a ''principal'' biodiversity objective that would not have been funded but for that objective and (b) activities marked ''significant'' that pursue other primary objectives ''but have been formulated or adjusted to help meet biodiversity concerns'' (OECD, 2015a, p. 4). In the first case, the marker identifies projects that directly aim to protect biodiversity or enhance sustainable use, for example, through the establishment of protected areas. In the second case, the marker identifies projects that can have significant cobenefits for biodiversity but for which biodiversity is not the primary focus (e.g., a project focused on enhancing agricultural production, while at the same time training smallholder farmers to combine native vegetation with crops for higher outputs and biodiversity protection). It is, however, also possible that the project's primary focus threatens biodiversity (e.g., road construction that cuts through the rainforest and fragments habitat) and that part of the funding is devoted to/reserved for biodiversity activities to mitigate or compensate these adverse effects. Hence, projects marked as significant are likely to affect biodiversity, but whether the project as a whole has a positive or negative impact on biodiversity will depend on the specific activities. Finally, in addition to addressing biodiversity loss/promoting biodiversity conservation, biodiversity aid projects can also have cobenefits for human health or livelihoods, something that both donor and recipient countries are also interested in assessing. The focus of this analysis, however, is specifically on the biodiversity-related outputs, outcomes, or impacts. Moreover, as mentioned earlier, a focus on ecosystem services may lead to selective protection of some ecosystem aspects and not always benefit biodiversity.

The biodiversity marker allows an approximate quantification of aid flows that target biodiversity objectives but cannot measure the exact amount of the project budget used for significant biodiversity objectives. This is because the ‘‘significant’’ marker applies to the whole project, while only part of the funding may be actually relevant to biodiversity conservation. Although the CRS data lists project-level activities, including a (relatively) long description, it is not possible to deduct the share of the project marked as significant. Most DAC members apply ‘‘coefficients’’ to flows marked with the ‘‘significant’’ biodiversity Rio marker to adjust the share of finance reported, for instance to the CBD, typically at aggregate level, ranging from 0% to 100%.[5] While the level of ODA targeting biodiversity as a principal objective is considered as the lower bound of ODA to biodiversity, the sum of biodiversity aid marked as ‘‘principal’’ and ‘‘significant’’ is considered to be the upper bound (Drutschinin & Ockenden, 2015).

Table 2 the top 10 donors and recipients of biodiversity aid in the period 2007–2012. The United States, Japan, and Germany committed more biodiversity aid than the other seven top donors together. While almost all G7 countries, with the exception of Italy, are among the top donors, smaller economies such as Norway, Greece, and the Netherlands also committed more than US$1,100 million. The average share of principal biodiversity aid varies strongly among the top 10 donors, from approximately 14% for Canada to approximately 88% for the United States.

The top three recipients of biodiversity aid, India, Brazil, and Vietnam, also figure prominently among the biodiversity hotspots (Conservation International, 2007; Mittermeier, Turner, Larsen, Brooks, & Gascon, 2011). Also, for recipients, the average share of principal biodiversity aid varies strongly, from as little as 12% in Ethiopia to as much as 88% in India.

The presentation of biodiversity aid statistics has, to date, typically been based on commitment data (OECD, 2014).[6] Rio markers are purpose based and seek information on the donors' policy objectives or intentions, rather than tracking and verifying that objectives have been met. They can therefore be best assessed at the design stage of projects. Donor governments assign Rio markers and, although criteria exist for their use, they are applied differently between donors. For climate-related aid, A. Michaelowa and Michaelowa (2011) found that the assigned code by the donor did not always match the project information provided by the donor, as a result of political preferences. Their exploratory analysis showed that climate aid was inflated through coding practices in a number of donor countries. The econometric analysis found that politicoeconomic factors such as ecological or ideological preferences were systematically related to the coding decision and led to over- or

**Table 2.** Top 10 Donors and Recipients, Biodiversity Aid Commitments, 2007–2013.

| Donor | Biodiversity aid, in US$ million | % Principal biodiversity aid | Recipient | Biodiversity aid, in US$ million | % Principal biodiversity aid |
|---|---|---|---|---|---|
| United States | 6,500 | 87.5 | India | 2,000 | 88.0 |
| Japan | 4,770 | 55.6 | Brazil | 1,980 | 64.6 |
| Germany | 4,490 | 19.3 | Vietnam | 1,790 | 73.2 |
| United Kingdom | 2,540 | 30.9 | China | 1,480 | 65.7 |
| Spain | 2,350 | 77.9 | Indonesia | 926 | 40.2 |
| France | 2,210 | 21.9 | Ethiopia | 710 | 11.8 |
| Canada | 1,950 | 14.3 | Kenya | 629 | 25.9 |
| Norway | 1,180 | 21.1 | Turkey | 578 | 30.8 |
| Greece | 1,180 | 15.0 | Peru | 538 | 75.1 |
| Netherlands | 1,130 | 19.6 | Bolivia | 482 | 28.8 |

*Note*. Donor contributions include regional (e.g., Africa, Central Asia) and unspecified bilateral aid commitments. % principal biodiversity aid = principal biodiversity aid as a % of total biodiversity aid, based on the principal Rio marker for biodiversity.

underreporting of climate change projects, beyond a simple random error. We are not aware of similar studies on biodiversity aid, but similar mismatches may exist for the biodiversity Rio marker. In principle, any Rio marker could be manipulated for political reasons, including the possibility to double count and rebadge conventional aid projects. In fact, the proportion of total biodiversity aid targeting multiple environmental objectives increased from an average of 46% in 2005–2007 to 79% in 2011–2013 (Drutschinin & Ockenden, 2015). It is unclear whether this was due to an increased awareness of the importance of biodiversity or due to an increased willingness to code projects as related to biodiversity/the environment for political reasons (e.g., the Strategic Plan for Biodiversity 2011–2020, adopted in 2010). Nonetheless, the share of bilateral biodiversity-related projects marked as significant increased from an estimated disbursement of US$3 billion in 2007 to US$6.25 billion in 2010, partly because ODA increased overall and partly because a greater percentage of aid was marked for biodiversity (Parker et al., 2012; similarly, Drutschinin & Ockenden, 2015). In conclusion, the OECD-DAC data continue to be the central database for ODA flows between donor and recipient. The drawbacks are that the OECD-DAC data provide an approximation of biodiversity funding, are limited to data on aid commitments, and contain data for relatively short time series only.

## Challenge 3: Linking Biodiversity Aid and Biodiversity Status

It is difficult to establish a causal link between activities aimed at biodiversity conservation, financed by biodiversity aid, and changes in biodiversity status at any scale and specifically at a national scale for four reasons: the complex functioning of ecosystems, the many factors influencing its status, the time lag before changes in biodiversity status are measurable, and the small proportion of aid relative to other financial flows. The distinction between principal and significant biodiversity aid further complicates this attribution. Biodiversity aid is clearly effective either if biodiversity is conserved or if biodiversity loss is slowed. As explained in the previous section, when a project is marked as significant for biodiversity, it can contribute to slowing biodiversity loss caused by other factors or it can mitigate biodiversity loss caused by the prime objective of the same project. Consequently, an empirical analysis studying the effectiveness of biodiversity aid must account for other factors, in addition to aid, that have either positively contributed to conserving biodiversity or to reducing biodiversity loss or have negatively contributed to continued or even accelerated biodiversity loss.

Biodiversity loss is driven by direct and indirect forces. Direct drivers include nutrient loading and pollution, land-use change, species introduction, overexploitation, and climate change (Millennium Ecosystem Assessment, 2005; SCBD, 2006). These five direct drivers are closely linked with indirect drivers, defined as multifaceted global and national forces that have an impact on biodiversity by influencing the quantity of resources used by human societies (SCBD, 2010). Indirect drivers include demographic change, economic activity levels (e.g., globalization and international trade), sociopolitical conditions (e.g., political regimes, institutions, and legal frameworks), changes in science and technology, and cultural and religious aspects (e.g., per capita consumption patterns linked to individual wealth and beliefs; Millennium Ecosystem Assessment, 2005; SCBD, 2006).

For individual projects, it may already be difficult to understand the role of the various driving forces, yet for an empirical assessment of aid effectiveness at a higher aggregation level, this is even more complicated. An empirical analysis needs to measure both direct and indirect causes of biodiversity loss in addition to factors that help conserve biodiversity. While straightforward from a theoretical perspective, it is difficult to empirically disentangle direct drivers from indirect drivers of biodiversity loss. This could be an argument for focusing on direct drivers. Yet, there again, empirical possibilities are severely constrained in the light of the very limited data availability for direct drivers of biodiversity loss. For instance, the crucial direct driver "climate change" (SCBD, 2014) is itself a multidimensional phenomenon and cannot be comprehensively represented by just one indicator due to the many proxies that would have to be considered at national level (e.g., rainfall variability, changes in mean temperature, occurrence of extreme weather events such as droughts, floods, storms). Thus, climate change as a global phenomenon would have to be made tangible at national level to fit the framework of the empirical analysis.

Waldron et al. (2017) offer an important step forward with what needs to be accounted for in an empirical assessment with balancing economic, agricultural, and population growth and conservation spending in their "pressures-and-conservation-impact-model" model. The econometric analysis uses proxy variables typically used in the aid literature and also considers possible interaction effects. It does not allow, however, to quantify the impact of biodiversity aid as it looks at aggregate conservation spending, including domestic funds.

As regards the time lag, conservation efforts are understood to have an impact only in the long term. Recipient countries estimated a period of 10 to 15 years before meaningful results could be obtained (Drutschinin et al., 2015). The reason for this is that conservation efforts financed by principal biodiversity aid will most likely not immediately impact the biodiversity status but rather manifest through a long-term process, from international budget allocation to national support to local activities. Miller, Rana, and Wahlén (2017) discuss how long-term impacts can be sensibly assessed in forest conservation and management interventions where results can take decades to materialize and suggest using predictive proxy indicators as "measures of outcomes taken during program implementation that are predictive of longer-term impacts" (p. 53).

In biodiversity aid, for instance, international funding can lead to the designation of a protected area that can contribute to inhibiting threats to species and ecosystems that ultimately impact on the biodiversity status. For biodiversity-related significant aid, the impact can be more immediate. For instance, a development project such as a hydropower reservoir can be designed to reduce its negative impact on biodiversity by choosing a run-of-river plant instead of a reservoir. While project-level information might be sufficient to determine the relevant time lag, the framework of the empirical analysis at cross-country level requires a single time lag, applicable to the entire data set, to be chosen.

Finally, biodiversity aid is small in proportion to all the other financial flows that support activities that either protect biodiversity or lead to its degradation. While individual projects may be effective (see, e.g., Dublin et al., 2004), their results may not be discernible in country-level measures of biodiversity. This situation is analogous to the micro–macro paradox in the aid literature, where aid is often found to generate positive local impacts even if its effects on national economic growth are hard to discern (Mosley, 1986, 1987; Riddell, 2007).

## Implications for Conservation

Biodiversity conservation and its sustainable use contribute to human well-being. Biodiversity aid continues being the major source for biodiversity conservation in low- and middle-income countries where much of the world's biodiversity is concentrated. Objective assessment of the effectiveness of biodiversity funding, beyond its allocation, is therefore valuable. Yet, as we aimed to demonstrate in this article, currently available data are unlikely to allow a satisfactory assessment of this sectoral aid at national level, while we do have evidence on the effectiveness at project level.

If global data fail to link biodiversity aid expenses to rates of biodiversity loss, this may be interpreted as biodiversity aid not being effective in conserving biodiversity or in generating win–win solutions or cobenefits, or even that in certain circumstances aid enhances biodiversity loss. The political implication would be to desist from financing biodiversity conservation and protection in developing countries via biodiversity aid and to use these funds for alternative purposes. An alternative interpretation could be that biodiversity aid is just insufficient to protect biodiversity against the many and strong driving forces leading to its loss. Biodiversity aid may have led to projects effectively protecting biodiversity, but the impacts of these individual projects may be untraceable at country-level analysis due to the high rates at which biodiversity is lost. In such a case, the political implication could be a scaling-up of biodiversity aid to increase the overall impact. A third interpretation could be that the best available data do not yet allow a meaningful analysis of how effective biodiversity aid is in conserving biodiversity and reducing biodiversity loss at national scale and that current results should not be used to support either of the two possible political choices described earlier.

The best conclusion from our analysis is therefore this last interpretation that highlights the need to improve the available data, because global biodiversity conservation would benefit most when international aid can be used in the most effective way. This could include a more structured assessment of the effectiveness of individual projects to help aggregating small effects into country effects and allowing a larger scale analysis. The political implication would then be to devote a greater share of biodiversity funds, if not additional funds, to measurement and data activities. Better data would allow expanding the model of Waldron et al. (2017) beyond mammals and birds and refining the method to also assess the effectiveness of biodiversity aid specifically.

More specifically, to obtain reliable and comparable data on biodiversity indicators and funding as a basis for establishing a sound link between the two, our findings indicate three necessary improvements to better assess the contribution of biodiversity aid to conserving biodiversity and to reducing biodiversity loss: (a) a more frequent assessment of the biodiversity status and trends at national level with higher consistency across countries, including output, outcome and, in particular, impact indicators; (b) a more exact quantification of biodiversity aid through a more homogenous method for all donor countries, and (c) an improved understanding of how biodiversity is lost and conserved and the role biodiversity aid plays in this complex relationship.[7]

A careful evaluation of what works and what does not will be beneficial to informed decision-making of all kinds of financiers on what projects to support financially and how they can be best supported. In the absence of the more detailed information about biodiversity status and aid, we suggest as an interim solution that allocation decisions for biodiversity aid should primarily be based on (a) aggregation of evidence of effectiveness of projects at local levels, (b) evidence of the effectiveness of overall biodiversity spending, of which biodiversity aid is a part, and (c) evidence of funding needs for biodiversity conservation.

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## Author Note

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## Notes

1. Biodiversity is the terrestrial and marine diversity within and between species and of ecosystems. It underpins renewable natural resources and provides numerous services to humankind. Four types of ecosystem services are distinguished: provisioning services such as food, water, timber, and fiber; regulating services that affect climate, floods, disease, wastes, and water quality; cultural services that provide recreational, aesthetic, and spiritual benefits; and supporting services such as soil formation, photosynthesis, and nutrient cycling (Millennium Ecosystem Assessment, 2005).
2. Current usage of the term biodiversity generally invokes genetic diversity, species diversity, and community diversity, and, within each, diversity can be characterized in three ways: (a) by the number of different entities, (b) by the relative abundance of the different entities, and (c) by the specific identities of the different entities (Ostfeld & Keesing, 2012).
3. ODA is defined as those flows to countries and territories on the DAC List of ODA Recipients and to multilateral development institutions that are (i) provided by official agencies, including state and local governments, or by their executing agencies and (ii) each transaction of which (a) is administered with the promotion of the economic development and welfare of developing countries as its main objective and (b) is concessional in character and conveys a grant element of at least 25% (calculated at a discount rate of 10%; OECD, 2015b).
4. The latest version (AidData, 2017) includes commitment information for over 1.5 million development finance activities, including biodiversity, funded between 1947 and 2013, covers 96 donors, and includes ODA, OOF flows, Equity Investments, and Export Credits where available. It is the most comprehensive project-level data set tracking international development finance.
5. Presentation at the Fourth Experts' Meeting of the Joint ENVIRONET-WP-STAT Task Team on OECD Rio Markers, Environment and Development Finance Statistics, 20–21 May, OECD, Paris.
6. In OECD accounting, commitments represent a firm written obligation by an official donor to provide, usually future and multiyear, specified assistance, while disbursements record the actual transaction of these financial resources in each year. Commitments thus reflect a donor's intentions in aid policies, while disbursements show their implementation. For further details, please refer to OECD (2018).
7. The OECD is working toward a modernized version of DAC's development finance statistics, including a range of international sources and channels of official finance, which will likely impact how biodiversity-related development finance will be monitored from 2018 onward (Drutschinin & Ockenden, 2015).

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