

# Wasted opportunities

Most ecological research does not reach its full potential, for reasons that range from poor design to publication bias to insufficient reporting. There are several straightforward steps that researchers, institutions, funders and publishers can take to cut the amount of wasted research.

An [Analysis in this issue](#) comes to the sobering conclusion that 82–89% of ecological research does not reach its full informative value; the authors define this as research waste. This is in line with earlier studies on [waste in medical research](#) and is likely to be similar across scientific disciplines. While it is unrealistic to expect that we can completely eliminate research waste, there are various measures that can be taken by different stakeholders that could lead to substantial reductions. Like medicine, ecology is a discipline crucial to a sustainable future, so there is a strong imperative, both financial and moral, not to waste research resources.

Purgar et al. conducted a meta-study of previous meta-analyses to get an overall picture of the extent and nature of research waste in ecology, encompassing 10,464 original studies. They show that about half the waste occurs because research does not make it through to publication and the other half because published research is not of a sufficient standard to be fully utilised. Research can fail to be published because the study design was not sufficiently robust or because publication ceases to be a priority given perceived interest level of the results or resourcing constraints. Published research can likewise have a flawed study design, making it unusable, or alternatively, the reporting of data or results might be insufficient. In addition to these factors, the authors note that accessibility of published research (whether it is open access) can affect how much value can be gained from it.

Rather than waste per se, the authors focus their suggested actions on reducing the unused potential of research. They define the unused potential as the impact research could have had if it had been better designed and reported. Unlike waste, which is the amount of poor design and reporting, unused potential is difficult to quantify.

On the basis of the results of Purgar et al., the first step in reducing unused potential should be improving study design so that wasteful research is not conducted in the first place. The quality of training and supervision of junior researchers is an important factor here, albeit with the caveat that we should not expect to completely eliminate waste as students should still be allowed to make

mistakes in preliminary explorations. Institutions and funders need to be rigorous in assessing proposals, for example, in ensuring the study design is sufficiently well powered to answer the research question, and such assessments should be ongoing rather than merely signing off on an initial proposal. Authors should also [apply evidence synthesis](#) to assess the landscape of previously conducted research when proposing a research question and a research design.

One of the most prominent proposals that the authors make for tackling waste due to poor design is the wider adoption of registered reports. Registered reports are a two-step publication process in which the initial study design undergoes peer review and acceptance in principle before the actual research is carried out. As long as the research is undertaken to the agreed plan, the results will be published regardless of their perceived interest. Several Nature journals now offer registered reports, and *Nature Ecology & Evolution* will be opening to stage 1 registered report submissions soon. It is also worth noting that when assessing manuscripts for publication, the question being asked and the extent and robustness of the methodology used are our primary focus, rather than the nature of the answer (for example, <https://doi.org/10.1038/s41559-020-1256-9>).

The second step in waste reduction is ensuring that all properly conducted research is published. Sound science journals such as our fellow Springer Nature journal *Scientific Reports* have a key part to play in reaching this goal. They offer to publish all research that is scientifically valid and technically sound, regardless of considered significance. At *Nature Ecology & Evolution*, although we have a high threshold for wide interest, we will suggest an alternative journal such as *Scientific Reports* for all studies that do not meet this threshold but that we consider potentially valid and sound, and we provide the authors with a link to transfer their submission if they choose.

Another source of unpublished research is chapters from undergraduate and doctoral theses that remain in institutional libraries without peer review, particularly in countries where publication is not a requirement for obtaining the degree. Institutions and funders should take steps to

get more of this research published in sound science journals.

Many steps have been taken by authors and journals to improve the reporting of published research. These include reproducibility checklists (for example, our own [reporting summary](#)) to ensure reviewers and readers have full access to the information they require, [integrated data submission](#) and robust requirements for data being made available in recognised repositories. This is why we ask all authors to upload data and only allow 'data available on request' in the rare circumstances where there is a privacy or proprietary constraint. Full access to reusable data is particularly important as often the data have at least as much value as, if not more than, the results themselves for [facilitating future research](#).

The authors of the Analysis note that they are unable to determine how waste has changed over time because most studies have looked at extended time windows such as all research published to date. We therefore do not yet know the relative effects of the interventions above, and determining that should be a priority. It is also important to note that different fields will have idiosyncratic requirements. For example, many studies in ecology are underpowered because of financial or logistical constraints, and the authors are careful to point out that this doesn't make them worthless, but does require caution and also highlights opportunities for coordination between studies. Similarly, blinding during data collection is generally an advantage, but is often impractical during field studies. However, blinding during data analysis may at least partially compensate for this.

By exposing the landscape of research waste, Purgar et al. have provided a valuable impetus to the ecology community to take up the proposals above. It is a topic that will require continual revisiting, as new methods will bring new ways in which waste might occur, and we need to ensure that the rate at which we reduce waste at least outpaces the appearance of these pitfalls. Research is expensive, and extracting maximum value from it is important for achieving a sustainable future. □

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