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### ‘Bronze’ open access supersedes green and gold

**Publishers can deny access to the majority of open-access articles at their discretion.**

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Jon Brock

Most open-access articles are not accompanied by a license, severely curtailing their use, a recent survey of 100,000 articles sampled from the CrossRef database has revealed.

Without a license, articles are free to read, but can't be redistributed or reused, for example, in presentations or course material, says Heather Piwowar, co-founder of the open science not-for-profit [ImpactStory](#), who led the analysis. Without explicit permission, they also can't be mined by computer software. "As artificial intelligence and machine learning become increasingly important tools, we need our research literature open and available for computational approaches to synthesize it, summarize it, and discover new patterns," she says.

Piwowar's study, published in *PeerJ*, shows a steady growth in open access since the 1990s, so that by 2016 it accounted for more than 40% of all research articles. This increase was driven by articles published in so-called gold open-access journals, in which all articles are free to read immediately upon publication, as well as hybrid journals, where authors can pay to release individual articles from behind a paywall.

The largest share of open-access articles belonged to a new category described by Piwowar and her co-authors as "bronze". These articles are available on websites hosted by their publisher — either immediately or following an embargo — but are not formally licensed for reuse.

The majority of open-access articles archived by CrossRef are not published with a formal license — a category dubbed "bronze".

Chart: Jon Brock Source: [Piwowar et al 2018, PeerJ](#) [Get the data](#) [Created with Datawrapper](#)

*The dip in 2016 may reflect the delay between publication of articles and their archiving in 'green' open-access repositories.*

The researchers excluded articles available on pirate sites such as Sci-Hub and academic social networks like ResearchGate that are vulnerable to takedown notices by copyright-holders.

Bronze is not a sustainable source of open-access literature, says Thed van Leeuwen, a senior researcher at the Centre for Science and Technology Studies of [Leiden University](#), who [has surveyed the open-access literature](#). "The publisher could decide to change the contents supplied to readers, so new publications are made open, while others disappear behind a paywall," he says. "No-one outside the publishing industry has influence on this."