



No buzz for bees: Media coverage of pollinator decline

Scott L. Althaus^{a,1}, May R. Berenbaum^{b,1}, Jenna Jordan^a, and Dan A. Shalmon^a

Edited by David L. Wagner, University of Connecticut, Storrs, CT, and accepted by Editorial Board Member Douglas Futuyama June 29, 2020 (received for review March 16, 2020)

Although widespread declines in insect biomass and diversity are increasing concerns within the scientific community, it remains unclear whether attention to pollinator declines has also increased within information sources serving the general public. Examining patterns of journalistic attention to the pollinator population crisis can also inform efforts to raise awareness about the importance of declines of insect species providing ecosystem services beyond pollination. We used the Global News Index developed by the Cline Center for Advanced Social Research at the University of Illinois at Urbana–Champaign to track news attention to pollinator topics in nearly 25 million news items published by two American national newspapers and four international wire services over the past four decades. We found vanishingly low levels of attention to pollinator population topics relative to coverage of climate change, which we use as a comparison topic. In the most recent subset of ~10 million stories published from 2007 to 2019, 1.39% (137,086 stories) refer to climate change/global warming while only 0.02% (1,780) refer to pollinator populations in all contexts, and just 0.007% (679) refer to pollinator declines. Substantial increases in news attention were detectable only in US national newspapers. We also find that, while climate change stories appear primarily in newspaper “front sections,” pollinator population stories remain largely marginalized in “science” and “back section” reports. At the same time, news reports about pollinator populations increasingly link the issue to climate change, which might ultimately help raise public awareness to effect needed policy changes.

news attention | insect decline | text data

Although many forms of global environmental change cannot definitively be attributed to human activities, human contributions to biodiversity loss are often well-documented. Recent studies documenting dramatic declines in insect diversity and biomass (summarized in refs. 1 and 2) have raised concerns within the entomological community about the magnitude and taxonomic extent of arthropod losses. A search of the Web of Science Core Collection with the search term “insect biodiversity” (3 March 2020) yielded a total of 194 papers published between 1994 and 2019, beginning with a single paper in 1994 and reaching a peak of 21 papers in 2018 (and 19 in 2019). In 2012, the number of citations to this growing body of literature reached 200 and more than doubled by 2019. A search of the specific topic “insect decline” yielded 22 publications, beginning with a

single paper published in 2015 and jumping to 15 papers published in 2019. The scientific literature reflects a burgeoning interest in this issue. Less clear, however, is whether this increasing level of scientific concern is reflected in journalistic coverage serving the general public.

The Rise of the Pollinator Crisis in the United States

Species decline and extinction gained widespread public attention in the United States around the beginning of the 20th century with an initial focus on birds, occasioned by exploitative hunting for the millinery trade, well-documented species declines, and several spectacular extinctions (including that of the passenger pigeon *Ectopistes migratorius*). Citizen activism and creation of conservation groups began

^aCline Center for Advanced Social Research, University of Illinois at Urbana–Champaign, Champaign, IL 61820-7478; and ^bDepartment of Entomology, University of Illinois at Urbana–Champaign, Urbana, IL 61801-3795

Author contributions: S.L.A., M.R.B., J.J., and D.A.S. designed research; S.L.A., J.J., and D.A.S. performed research; S.L.A., J.J., and D.A.S. analyzed data; and S.L.A. and M.R.B. wrote the paper.

The authors declare no competing interest.

This article is a PNAS Direct Submission. D.L.W. is a guest editor invited by the Editorial Board.

Published under the PNAS license.

¹To whom correspondence may be addressed. Email: salthaus@illinois.edu or maybe@illinois.edu.

This article contains supporting information online at <https://www.pnas.org/lookup/suppl/doi:10.1073/pnas.2002552117/-/DCSupplemental>.

Published January 11, 2021.

initially at the state level and culminated in the 1905 founding of a dedicated national organization, the National Audubon Society. The most tangible evidence of the commitment and influence of this group and its allies was the 1918 passage of the Migratory Bird Treaty Act under President Woodrow Wilson, a landmark piece of legislation that empowered the federal government to regulate hunting and to protect wildlife.

Conservation concerns about insects also began to increase during the early 20th century. W. J. Holland (3), for example, remarked on the virtual disappearance of the formerly abundant rosy maple-moth *Anisota rubicunda* in Pittsburgh, which he attributed to the proliferation of artificial light sources—but, for decades, organized efforts to protect insects were limited to the professional and dedicated amateur entomological community. In England, famed lepidopterist Walter Rothschild chaired the newly constituted Committee for the Protection of British Lepidoptera for the Royal Entomological Society of London. By 1935, Entomological Society of America President Edith Patch devoted her presidential address to the concept of protecting beneficial insects (4).

Popular interest in insect conservation began to grow noticeably in the wake of the 1962 publication of *Silent Spring* (5), a compelling book that documented adverse impacts from overuse of synthetic organic insecticides on arthropods and the animals that feed on them and that argued for a more balanced and rational approach to insect management. Among the many examples cited in support of her argument, Carson (5) referenced the aerial applications of DDT for gypsy moth control in New York State and elsewhere that led to massive losses of honey bees and subsequent lawsuits filed by beekeepers, remarking, “It is a very distressful thing...to walk into a yard in May and not hear a bee buzz.” The general backlash against pesticide abuses led to elevated concerns about nontarget impacts on beneficial species other than bees, and the scientific community partnered with concerned citizens to raise awareness and demand legislative action to protect insects. The Xerces Society was founded in 1971, and its initial dedication to Lepidoptera eventually expanded to encompass all invertebrates. Passage of the federal Endangered Species Act in 1973 added momentum, with the first insect species—the Schaus swallowtail—listed in 1976.

In the ensuing decade, legendary insect expert E. O. Wilson authored a widely cited scientific article about insect biodiversity (6) as well as a high-profile newspaper piece on biodiversity loss in general (7). In 1992, he introduced the phrase “crisis of biodiversity” to the general public in his popular book, *The Diversity of Life* (8). Intensification of concerns among entomologists about insect biodiversity losses led David Wagner of the University of Connecticut-Storrs to organize the Entomological Society of America’s first symposium on insect conservation in 1995.

Even though insects may be at proportionately greater risk of extinction than other animals (9), they have until recently been left out of most public discussions of biodiversity loss. It is difficult to anticipate public reactions to the growing body of recent scientific evidence documenting a biodiversity crisis among insects generally, but insight can be gained through a focused analysis of the “pollinator crisis,” formally recognized by the scientific community since 1996 in several key actions by the Convention on Biodiversity. The history of concern about the “forgotten pollinators,” as dubbed by Buchmann and Nabhan (10), is reviewed in the National Research Council’s *Status of Pollinators in North America* (11). In brief, in September 1996, the Subsidiary Body on Scientific Technical and Technological Advice of Convention

on Biodiversity, Montreal, launched an “international pollinator conservation initiative,” and, 2 months later, the Third Conference of the Parties to the Convention on Biodiversity, Buenos Aires Decision III.11 designated pollinators as a “priority group.” By 1998, at the International Workshop on Conservation and Sustainable Use of Pollinators in Agriculture, the *São Paulo Declaration on Pollinators* was issued, and, by 2002, the International Pollinators Initiative was approved at the Sixth Session of the Conference of the Parties (COP6), in The Netherlands. In the United States, the National Academy of Sciences’ National Research Council, prompted by requests from the North American Pollinator Protection Campaign, authorized the formation of a study committee to determine the status of pollinators in North America, with funding from the US Department of Agriculture, the US Geological Survey, and The National Academies.

In 2006, the National Research Council released report findings that documented a long-term downward population trend for honey bees in the United States, which—if the decline continued at the rates exhibited from 1989 to 1996—would cause the US commercial honey bee population to “vanish by 2035” (p. 118). With a few exceptions, including monarch butterflies and several bumble bee species that had been the focus of long-term studies, data for other insect species were inadequate for evaluating the status of North American pollinators. The initial release of the report in October 2006 coincided with the first reports among beekeepers of sudden inexplicable colony deaths that ultimately became known as Colony Collapse Disorder. Early news reports of mystifying bee colony losses across the country led to a massive increase in media attention over the following 6 months (12). By May 2007, the Pollinator Habitat Protection Act (S. 1496) was introduced by Senator Max Baucus and aimed at improving habitat for native and managed pollinators. In June 2007, Senator Barbara Boxer introduced the Pollinator Protection Act (S. 1694), and, in the same month, Congressman Earl Blumenauer proposed similar legislation in the House (H.R. 2913). Over the course of the “beepocalypse,” annual persistent colony losses that averaged 30% or more of America’s honey bee colonies for several years drew increasing news recognition to dramatic declines, not just in honey bees but in other pollinator groups, most notably wild bees and monarch butterflies. These losses also led to five iterations (most recently in 2019) of the Save America’s Pollinators Act, introduced by Blumenauer in 2013 but never yet put to a vote (13).

In short, this historical review suggests that an emerging awareness of pollinator population problems over the last century appears to have grown sharply over the past 12 years with increasingly visible and substantive efforts at pollinator protection. As Simaika and Samways (14) point out,

the pollinator crisis...has stimulated huge efforts towards correcting it in many parts of the world...This has also gone hand in hand with concerns over use of pesticides, especially certain categories like the neonicotinoids, and the realization that both our food base and health are being compromised. Interestingly, the pollinator crisis focuses on two flash points in our psyche: “the bee” and “our health.” The bee (at least the bumble bee) is a flagship insect, easy to recognize, characteristic and valuable, and something that people can associate with positively...Bees are tangible and conceptually accessible, and move insect empathy into the realms seen for attractive birds and mammals. Indeed, some insects do better in likability tests than vertebrate competitors.

It remains unclear, however, whether the increasing pace and widening scale of these efforts to address the pollinator crisis have generated a parallel increase in media attention to the concerning declines in insect populations that provide ecosystem services. Media attention to pollinator declines is required to raise public awareness of the problem and to pressure governing institutions to prioritize and pass effective policies for addressing the crisis. Yet, to date, there has been no systematic research on media coverage of pollinator decline. In the pages that follow, we provide the first such analysis to clarify whether levels of media attention to pollinator decline reflect growing levels of concern within the scientific community.

Trends in Pollinator News Coverage over the Last Four Decades

We used the Global News Index developed by the Cline Center for Advanced Social Research at the University of Illinois Urbana-Champaign (15) to track global news attention to pollinator topics. This resource consists of a full-text index and a set of features extracted by the Cline Center from over 150 million English-language news reports using a suite of Natural Language Processing and Machine Learning algorithms. Our analysis consists of Boolean keyword searches across the complete population of several decades of published news content from two leading US national newspapers and four of the world's most prestigious wire services.

National news coverage in the United States is represented by *The New York Times* (NYT), consisting of 3,799,992 stories from 1980 through 2019 (averaging 1,856 stories per week), and *The Washington Post* (WP), with a combined 3,560,916 stories from 1977 through 2019 (averaging 1,600 stories per week). Wire service coverage is represented by *The Associated Press* (AP), headquartered in the United States, with a total output of 7,539,180 stories from 1977 through 2019 (averaging 3,388 stories per week); *Agence France Presse* (AFP), headquartered in France, with a total output of 4,264,932 stories from 1991 through 2019 (averaging 2,888 stories per week); *Deutsche Presse Agentur* (DPA), headquartered in Germany, publishing 1,528,692 stories from 1994 through 2019 (averaging 1,165 stories per week); and *Xinhua General News Service* (XGNS), headquartered in China, consisting of 3,956,731 stories from 1977 through 2019 (averaging 1,778 stories per week). Our analysis therefore analyzes content from a combined 24,650,443 news items published in English between 1 January 1977 and 18 August 2019.

News trends at these scales are complex, multidimensional, and formed by internal logics that diverge across news organizations (e.g., refs. 16–19). To provide a point of reference for evaluating the level of attention paid by news media to environmental issues, we compared news coverage of pollinator population topics to news coverage of climate change. For the latter, we adopted an approach used in several widely cited papers (20–22) by searching for news stories referring to either “climate change” or “global warming.” (Several robustness checks on this query confirming the validity of this approach are provided in [SI Appendix, Supplemental Material](#).)

The parallel search for pollinator topics is complicated by the tendency for both “bees” and “butterflies” to be referenced across a diverse range of topics unrelated to ecology. Over the time period examined, for example, the word “bees” has appeared in news stories about movies (e.g., *Bumblebee*, 2018), country songs (e.g., *Honey Bee*, 2011), and minor league baseball teams (e.g., Salt Lake Bees). To address this challenge, we

developed a search query for pollinator population topics that required relevant news stories to mention the following: 1) insect pollinators, 2) insect populations writ large, and 3) scientific research or data. Validation tests on our query confirmed that it has high recall and moderate precision: While it recovers nearly all news reports that mention pollinator populations at least briefly, about half of the reports picked up by the query contain no actual mention of a pollinator population. Taken together, this means that the trends reported below on news attention to pollinator populations most likely overstate the actual amount of news attention given to this topic: Actual levels of news attention to pollinator populations are likely to be even lower than our results indicate. (Full details on all queries and validation tests are included in [SI Appendix, Supplemental Material](#).)

Pollinator Populations vs. Climate Change

Neither climate change nor pollinator populations have been topics of more than modest news interest across the past four decades of coverage, but climate change receives orders of magnitude more attention than pollinator topics. Within the full set of nearly 25 million news stories, 166,734 make reference to climate change while just 3,410 mention pollinator populations. Expanding the pollinator portion of the query to include any mention of the word “insect” all by itself increases the total to only 8,566 stories: Either way, news stories about insect populations are rare in four decades of news coverage. Yet, because these topics have both become especially salient in recent years, a clearer picture of their relative prominence can be gained by limiting the time period of interest to the 13 years from 2007 through 2019, a period that begins with the publication of the National Research Council's report, *Status of Pollinators in North America* (11), and coincides with growing public discussion of Colony Collapse Disorder.

Of the nearly 10 million news stories published by the six sources during this 13-year period, only 1.39% ($n = 137,086$ stories) refer to climate change or global warming, compared to 0.02% ($n = 1,780$) that refer to pollinator populations in all contexts (i.e., not just those associated with pollinator declines). Adding additional terms requiring that articles also contain references to pollinator declines reduces the total number of stories to 679 stories across the six news outlets, representing 0.007% of total news attention for the period. (Details on the pollinator population decline query are available in [SI Appendix, Supplemental Material](#).)

To put this percentage in perspective, a recent study of 27 topics making the front pages of NYT between 1996 and 2006 (23) found that the most frequently featured topic was international affairs (21% of total coverage), followed by military issues and wars (14%). Only 1.1% of front page NYT coverage in that study addressed environmental issues or natural disasters, so our finding of 1.4% attention to climate change topics in recent years is comparable with NYT editorial decisions in this topic area. In this context, it is difficult to imagine how the collective impact of 679 news reports mentioning pollinator population declines out of nearly 10 million total stories could motivate large numbers of readers to demand government action to reverse the downward trends.

Trends in Pollinator and Climate Change News Coverage over Time

Even though news attention to pollinator populations has been limited over four decades of coverage, interest in this topic is

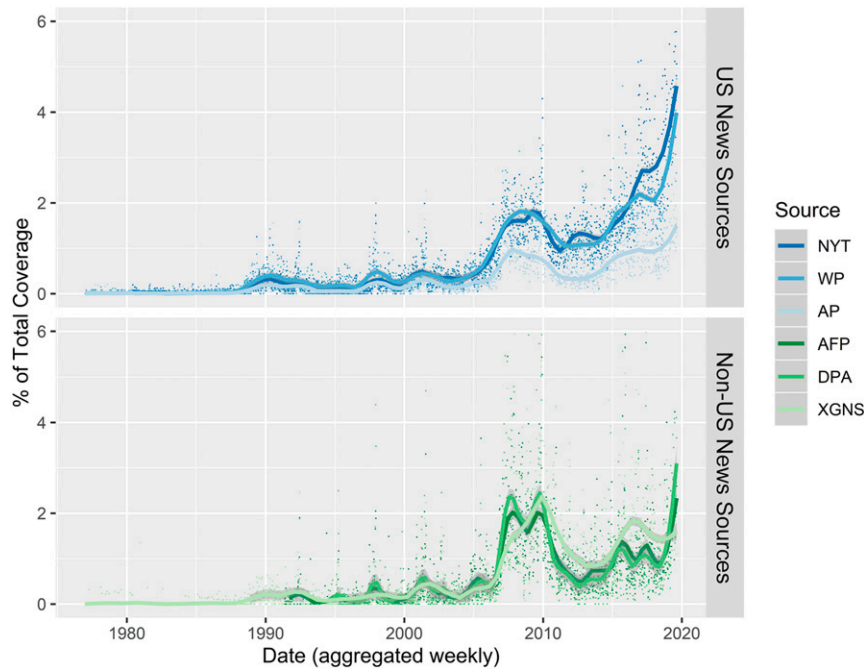


Fig. 1. Levels of attention to climate change in both US and non-US news sources from 1977 to 2019 across nearly 25 million news reports, shown as the percentage of total weekly news output in each source that mentions climate change or global warming. Blue lines are US news sources; green lines are non-US news sources. Note that, in contrast to Fig. 2, the y axis runs from 0.0 to 6.0 percentage points of total coverage.

starting to increase in some news outlets. Again, the contrast with climate change coverage is informative. Fig. 1 shows the emergence of climate change coverage in American outlets and in non-American wire service reporting. Overlaying scatterplots of weekly news values with locally weighted scatterplot smoothing (LOWESS) trend lines for each series reveals that, in both US and non-US coverage, there is a gradual rise in attention to climate change issues starting in the late 1980s and accelerating upward in 2007 (Pearson correlations between percentage of climate change coverage and elapsed weeks from 1977 to 2019 range from a low of +0.34 for DPA to a high of +0.78 for WP, all significant at $P < 0.001$). This initial surge in climate change attention was larger outside than inside the United States, but, since that time, sustained attention to climate change has been proportionally greater in American national newspapers than in non-US wire service reporting. By 2019, a weekly average of 4.0% of NYT and 3.5% of WP stories mentioned climate change or global warming at least once, compared to 1.3% of AP stories and between 1.5 and 2.1% percent of non-US wire service stories (one-way ANOVA, $F[5, 192] = 72.4, P < 0.001$). In 2019, only AP and DPA had significant differences in climate coverage among the four wire services; there were no significant differences between the two newspapers, but consistently significant differences between each of the newspapers and each of the wire services (Scheffé post hoc contrasts at $P < 0.05$; details in [SI Appendix, Supplemental Material](#)).

The trends for pollinator population coverage differ dramatically from trends in climate change coverage (Fig. 2). Comparing the percentage of coverage given to pollinator populations by US outlets and non-US wire services demonstrates that wire services outside the United States consistently pay negligible attention to the topic. Across four decades, the combined story count addressing pollinator population topics in AFP, DPA, and XGNS was 347 reports out of 9.7 million stories (Pearson correlations

between percentage of pollinator population coverage and elapsed weeks from 1977 to 2019 are nonsignificant for DPA and XGNS, but +0.29 for AFP at $P < 0.001$, reflecting merely that 147 of AFP's 171 total pollinator population stories were published after 2006). In contrast, the three American outlets published a combined 3,063 stories mentioning pollinator populations out of 14.9 million total stories, of which only 623 were published by AP. As shown in Fig. 2, historically sporadic levels of attention in the two national newspapers have trended consistently upward in the last few years, with NYT in the lead (Pearson correlations between percentage of pollinator population coverage and elapsed weeks from 1977 to 2019 are nonsignificant for AP, but +0.22 for NYT and +0.23 for WP, both significant at $P < 0.001$).

Notwithstanding this apparent difference, the absolute amount of coverage in both newspapers remains small. In 2019, a weekly average of 0.12% of NYT and 0.08% of WP stories mentioned pollinator populations at least briefly, compared to 0.01% of stories from AP, AFP, and XGNS, with DPA publishing less than half that amount (one-way ANOVA, $F[5, 192] = 21.5, P < 0.001$). Differences in 2019 among the four wire services are nonsignificant, as is the difference between the two newspapers, but differences between each of the newspapers and each of the wire services are all significant (Scheffé post hoc contrasts; details in [SI Appendix, Supplemental Material](#)). It is important to keep in mind that, because only 28% of these few stories address pollinator declines, no trends in levels of decline coverage can be reliably inferred across these six outlets: There is simply too little pollinator decline attention to permit such an analysis.

A clear pattern is emerging, however, in news coverage of pollinator populations: These stories are increasingly likely also to mention climate change. In the pooled trend across all six news outlets, only 3% of pollinator population stories published before 2007 mentioned climate change (Fig. 3). In contrast, fully 23% of

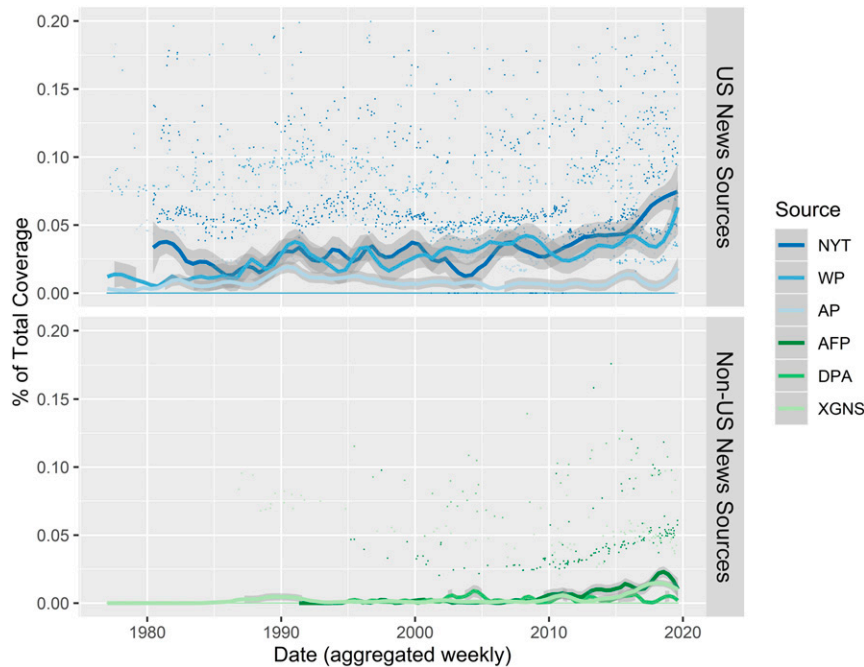


Fig. 2. Levels of attention to pollinator populations in both US and non-US news sources from 1977 to 2019 across nearly 25 million news reports, shown as the percentage of total weekly news output in each source that mentions pollinator population terms. Blue lines are US news sources; green lines are non-US news sources. Note that, in contrast to Fig. 1, the y axis runs from 0.0 to 0.2 percentage points of total coverage. If the trends in this figure were overlaid on Fig. 1's more expansive y axis, the result would appear to be a darkened cluster of lines slightly above the zero point for all decades.

stories published between 2007 and 2019 referred to the warming climate. In 2019 alone, 43% of pollinator population stories made at least one mention of either climate change or global warming. The Pearson correlation between year and mentioning climate change is robust, at $+0.83$ ($P < 0.001$). Despite this steady shift, the small absolute number of pollinator stories means that climate change coverage remains focused on topics other than pollinator populations. Out of 166,734 stories mentioning climate change across the six outlets, just 457 also mention pollinator populations, comprising only 0.3% of climate change stories.

With wire service reporting, it is difficult to know which stories get picked up by subscribing outlets, and how prominently those outlets place the stories in their mix of news coverage. With newspaper reporting, however, stories are assigned to topical sections that reflect whether stories are considered as mainstream public affairs reporting. We illustrate this tendency with reporting from NYT from 2007 to 2019, which features the most extensive coverage of pollinator populations among the six outlets we examined. Fig. 4 is a pair of stacked area charts showing the distribution of pollinator population stories across topical sections in NYT. Topical sections include Science, mainstream "Front Section" public affairs reporting (considered to be national, international, news review, and editorial/opinion sections, along with reports in the business and finance sections), and all other sections, comprising mostly local stories, feature stories, or special section coverage (e.g., "Weekend," "Education," and "Smarter Living" sections).

For the most part, the small amount of NYT coverage of pollinator populations is consigned to Science and "Back Section" reporting (Fig. 4A), which further limits the potential readership (24). In 2007, 21% of pollinator population stories appeared in the Science section (Fig. 4A, green area), 24% appeared in "Front

Section" stories (Fig. 4A, blue-shaded areas), and 55% appeared in other "Back Section" parts of the paper (Fig. 4A, white area). Despite more than a decade of expanding scientific attention to pollinator issues, this mix of sections was largely unchanged 12 years later: In 2019, 26% of pollinator population stories appeared in the Science section, 24% appeared in "Front Section" reporting, and 50% were published in other sections. Statistically, the Pearson correlation between year and the "Front Section" percentage in Fig. 4A is a nonsignificant $+0.39$ ($P = 0.19$), similar to the nonsignificant $+0.17$ correlation with year for Science percentage ($P = 0.59$), but in contrast to the significant -0.56 correlation for other section coverage ($P < 0.05$).

Unlike pollinator population coverage, climate change stories have successfully moved out of Science section reporting and into mainstream reporting on public affairs (Fig. 4B). With respect to climate change, 57% of stories in 2007 and 66% of stories in 2019 appeared as "Front Section" coverage in either the national, international, news review, business/finance, or editorial/opinion pages. The Pearson correlation between year and the "Front Section" percentage in Fig. 4B is $+0.65$, $P < 0.05$. In contrast, only 9% in 2007 and 8% in 2019 appeared in the Science section, with the remainder of climate change stories appearing in other "Back Section" areas of NYT. The Pearson correlations for these relationships are negative but nonsignificant (for Science section and year, $r = -0.41$, $P = 0.17$; for other section and year, $r = -0.47$, $P = 0.11$).

"Back Section" reporting can occasionally be important for raising public awareness, as demonstrated by the November 2018 publication of Brooke Jarvis's "The Insect Apocalypse Is Here" cover story in *The New York Times Magazine* (25), which generated a considerable amount of interest around the world beyond the scientific community. In-depth feature stories like this

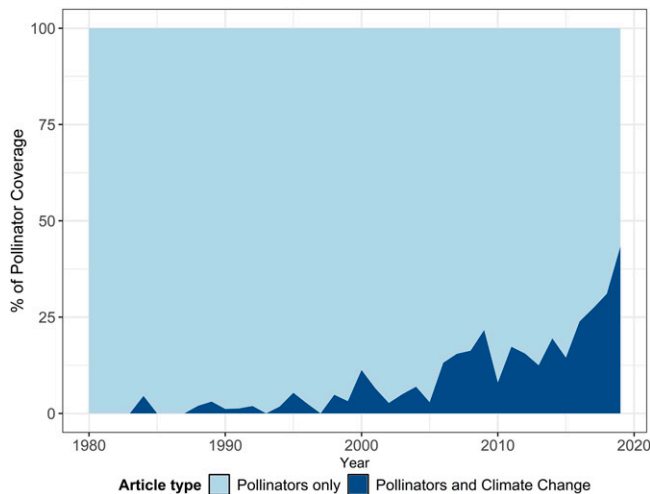


Fig. 3. Percentage of the stories mentioning pollinator populations across six news sources that also mention climate change or global warming (dark blue). Light blue area shows percentage of this coverage that mentions only pollinator populations.

one can be consequential for drawing attention to an issue in the short term, but their capacity to sustain mainstream news interest is limited. Sustained “Front Section” news attention is difficult to achieve without either institutional uptake by governmental authorities or a high-profile event that galvanizes public interest (e.g., refs. 23 and 26). Conventional approaches for disseminating pollinator population research through the scientific community via peer-reviewed journals offer little chance for either.

Attracting News Attention and Inspiring Action

Our analysis of nearly 25 million news items published by six sources across four decades turned up only 3,410 stories that clearly mentioned pollinator population research. Of these, only 950 stories, or 0.004% of the total, unambiguously discussed declines in pollinator populations, and only 126 of the decline stories appeared in news outlets from sources outside the United States. The largest share of this coverage appeared in national newspapers recognized by the American social science community as targeting American elites. Beyond that audience, issues related to pollinator populations appear to be largely overlooked by wire services around the world that have greater potential to raise popular awareness of important issues. This is the scientific community’s record to date at raising public awareness of the problem of declining pollinator populations.

For more than a decade, members of the scientific community have been frustrated with the challenge of engaging the public in issues relating to biodiversity. Novacek (27) lamented that “arguments from the media and other sources...discourage public interest in environmental topics by characterizing the science behind them as overly complex, immersed in debate and controversy, and detached from human interests” and asked “why has a massive, international effort to deal with the biodiversity crisis failed to launch? Much of the current stasis is ascribed to the antagonism of corporate interests and lack of vision, and even resistance, of leaders and governments.... [I]f a lack of public understanding or concern persists, it is highly unlikely that either governments or businesses will change course.”

Given the important role that media attention could play in stimulating and sustaining public understanding of and concern

for pollinator declines, some reasons why this important issue continues to be neglected in news coverage are deserving of mention. An extensive literature in political communication offers some clear insights that the rest of the scientific community would do well to mark. Changes in public opinion bring about changes in public policy (28, 29), and mainstream media attention is an important agent for raising public awareness, focusing public attention, and framing issues in ways that attract the notice of policymakers (30, 31). Yet, compared to times past when the front pages of NYT and WP could be counted on to drive media agendas across the United States (e.g., ref. 32), news attention in today’s highly fragmented media space is also shaped by partisan media (33), social media (34), and specialized media (35). This increasingly complex attentional space provides ample opportunities for previously marginalized political issues to move onto the agendas of policymaking institutions (31), as can be seen in successful efforts to raise the public salience of environmental pollution risks (e.g., ref. 36) and climate change (e.g., ref. 37). In short, policy change tends to follow large and sustained shifts in media attention to particular problems. The important question is therefore what holds mainstream news outlets back from providing sustained informational focus to pollinator declines.

Among the many plausible reasons why media coverage of pollinator populations remains scant, two stand out as particularly likely. First, declines in pollinator populations happen gradually and are difficult to observe let alone enumerate on a global scale.

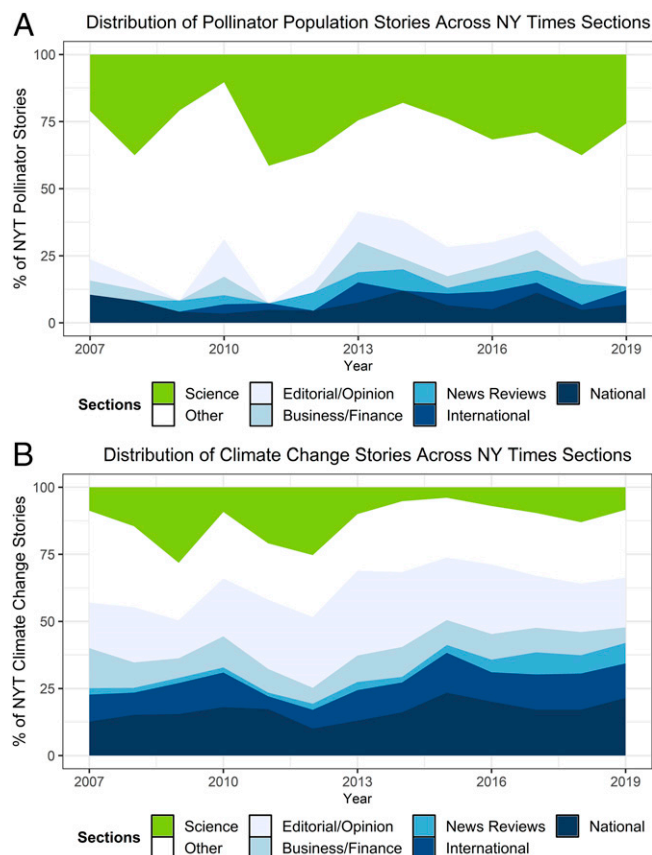


Fig. 4. Distribution of pollinator population stories (A) and climate change stories (B) across NYT sections by year from 2007 to 2019. Green indicates Science Section reporting, blue indicates “Front Section” reporting, and white indicates all other sections.

The incremental and often invisible progress of pollinator declines makes it extremely difficult for news organizations to report on consistently and sustain audience interest in dwindling pollinator populations. It would be a different matter if such declines were to occur in a small number of discrete, dramatic, and rapidly unfolding events. One suspects that, if all of the bee colonies in North America were gathered to a single location that was subsequently hit by an asteroid, sustained news attention to such a spectacular and catastrophic event would be guaranteed. In contrast, occasional publications of even high-profile scientific reports have little ability on their own to attract or catalyze mainstream media attention for slow-moving and hard-to-see problems such as pollinator declines.

A second reason for limited news coverage is that cash-strapped media organizations are forced as a matter of cost efficiency to monitor the world largely by shadowing the activities of governing institutions (38, 39). Study after study has found that the main topics of mainstream news coverage are a small subset of governmental activities and decisions that already are (or can be made to seem) interesting to audiences (16, 40). If government leaders and major party candidates are ignoring a topic, news outlets will likely ignore it too. Getting the topic of pollinator declines onto the agenda of governing institutions is therefore a key opportunity to raise levels of media attention and, in turn, popular concern.

This suggests that the remarkably low level of news attention to the pollinator crisis revealed in our analysis may follow in part from the failure of governments to pass comprehensive legislation to protect pollinators. In the United States, arguably the most consequential policy effort to protect pollinators since publication of the National Research Council's 2007 report on pollinators (11) may well have been a single Presidential memorandum (41). In this light, the increasing tendency in both news coverage and scientific reports to link pollinator declines with climate change has potential to help the chances for getting the diminishing vibrancy and diversity of key insect populations onto the policy

agendas of governing institutions. Indeed, a Web of Science Core Collection search conducted on 14 March 2020 of "pollinator decline" as a topic yielded 195 articles; adding the search term "climate change" reduced the number of articles to 28, the first of which appeared in 2005. Between 2005 and 2010, a total of three papers were published; between 2010 and 2015, six papers were published; and between 2016 and the first 2 months of 2020, 19 papers mentioning both pollinator declines and climate change were published. Moreover, citations of these papers rose from 97 in 2018 to 141 in 2019, an increase of almost 50% in a single year. This small start, if it continues, offers an opportunity for connecting the relatively unfamiliar and hard-to-report topic such as pollinator declines to a news topic that already has its place in the media agenda: climate change.

Should this trend continue, media attention to climate change—which over the past two decades has been orders of magnitude greater than attention to pollinator decline—could be the connection that ultimately succeeds in stimulating and maintaining public concern about the shrinking biomass and diversity of insect pollinators. It remains an open question whether media coverage alone can increase public awareness high enough, and quickly enough, to effect the significant policy change required to decisively slow, halt, or even reverse pollinator losses.

Data Availability. Supplemental materials as well as all data and code for replicating the analyses are available on the Illinois Data Bank (<https://databank.illinois.edu/>) and can be found at https://doi.org/10.13012/B2IDB-4237085_V1.

Acknowledgments

Author names are listed in alphabetical order rather than order of contribution. We thank the Cline Center for Advanced Social Research (University of Illinois at Urbana-Champaign) for generous use of its Global News Index data; and the three anonymous reviewers whose feedback substantially sharpened the analysis.

- 1 D. L. Wagner, Insect declines in the anthropocene. *Annu. Rev. Entomol.* **65**, 457–480 (2020).
- 2 R. van Klink *et al.*, Meta-analysis reveals declines in terrestrial but increases in freshwater insect abundances. *Science* **368**, 417–420 (2020).
- 3 W. J. Holland, *The Moth Book: A Popular Guide to a Knowledge of the Moths of North America* (Doubleday, Page & Co., New York, 1903).
- 4 R. M. Pyle, "The origins and history of insect conservation in the United States" in *Insect Conservation: Past, Present and Prospects*, T. R. New, Ed. (Springer Netherlands, Dordrecht, 2012), pp. 157–170.
- 5 R. Carson, *Silent Spring* (Houghton Mifflin, New York, 1962).
- 6 E. O. Wilson, The little things that run the world (The importance and conservation of invertebrates). *Conserv. Biol.* **1**, 344–346 (1987).
- 7 E. O. Wilson, Is humanity suicidal? If *Homo sapiens* goes the way of the dinosaur, we have only ourselves to blame. *NY Times Magazine*, 30 May 1993, Section 6, p. 24.
- 8 E. O. Wilson, *The Diversity of Life* (W. W. Norton & Company, New York, 1992).
- 9 R. R. Dunn, Modern insect extinctions, the neglected majority. *Conserv. Biol.* **19**, 1030–1036 (2005).
- 10 S. L. Buchmann, G. P. Nabhan, *The Forgotten Pollinators* (Island Press, Washington, DC, 1996).
- 11 National Research Council, *Status of Pollinators in North America* (The National Academies Press, Washington, DC, 2007).
- 12 M. R. Berenbaum, Bees in crisis: Colony collapse, honey laundering, and other problems bee-setting American apiculture. *Proc. Am. Philos. Soc.* **158**, 229–247 (2014).
- 13 I. Graber-Stiehl, New law would help bees—but could leave other pollinators out in the cold. *Sci. Am.*, 24 May 2019. <https://www.scientificamerican.com/article/new-law-would-help-bees-but-could-leave-other-pollinators-out-in-the-cold/>. Accessed 1 June 2020.
- 14 J. P. Simaika, M. J. Samways, Biophilia as a universal ethic for conserving biodiversity. *Conserv. Biol.* **24**, 903–906 (2010).
- 15 Cline Center for Advanced Social Research, Global News Index and Extracted Features Repository. https://doi.org/10.13012/B2IDB-5649852_V1. Accessed 1 June 2020.
- 16 S. L. Althaus *et al.*, Assumed transmission in political science: A call for bringing description back in. *J. Polit.* **73**, 1065–1080 (2011).
- 17 F. Esser, T. Hanitzsch, Eds., *The Handbook of Comparative Communication Research* (Routledge, New York, 2012).
- 18 M. Hellman, K. Riegert, "Emerging transnational news spheres in global crisis reporting" in *The Handbook Of Global Media Research*, I. Volkmer, Ed. (Wiley-Blackwell, 2012), pp. 156–174.
- 19 J. Hong, From the world's largest propaganda machine to a multipurposed global news agency: Factors in and implications of Xinhua's transformation since 1978. *Polit. Commun.* **28**, 377–393 (2011).
- 20 M. T. Boykoff, Flogging a dead norm? Newspaper coverage of anthropogenic climate change in the United States and United Kingdom from 2003 to 2006. *Area* **39**, 470–481 (2007).

- 21 A. Schmidt, A. Ivanova, M. S. Schäfer, Media attention for climate change around the world: A comparative analysis of newspaper coverage in 27 countries. *Glob. Environ. Change* **23**, 1233–1248 (2013).
- 22 L. Antilla, Climate of scepticism: US newspaper coverage of the science of climate change. *Glob. Environ. Change* **15**, 338–352 (2005).
- 23 A. E. Boydstun, *Making The News: Politics, the Media, and Agenda-Setting* (University of Chicago Press, Chicago, IL, 2013).
- 24 L. Bogart, *Press and Public: Who Reads What, When, Where, and Why in American Newspapers* (Erlbaum, Hillsdale, NJ, ed. 2, 1989).
- 25 B. Jarvis, The insect apocalypse is here, *NY Times Magazine*, 27 November 2018. <https://www.nytimes.com/2018/11/27/magazine/insect-apocalypse.html>. Accessed 1 June 2020.
- 26 G. Wolfsfeld, *Media and the Path to Peace* (Cambridge University Press, New York, 2004).
- 27 M. J. Novacek, Colloquium paper: Engaging the public in biodiversity issues. *Proc. Natl. Acad. Sci. U.S.A.* **105** (suppl. 1), 11571–11578 (2008).
- 28 J. A. Stimson, M. B. MacKuen, R. S. Erikson, Dynamic representation. *Am. Political Sci. Rev.* **89**, 543–565 (1995).
- 29 S. N. Soroka, C. Wlezien, *Degrees Of Democracy: Politics, Public Opinion, and Policy* (Cambridge University Press, New York, 2010).
- 30 Y. Tan, D. H. Weaver, Agenda-setting effects among the media, the public, and congress, 1946–2004. *J. Mass Commun. Q.* **84**, 729–744 (2007).
- 31 T. A. Birkland, “Agenda setting in public policy” in *Handbook of Public Policy Analysis*, F. Fischer, G. J. Miller, M. S. Sidney, Eds. (Routledge, New York, 2007), pp. 63–78.
- 32 G. Golan, Intermedia agenda setting and global news coverage: Assessing the influence of the New York Times on three television evening news programs. *J. Stud.* **7**, 323–333 (2006).
- 33 C. J. Vargo, L. Guo, Networks, big data, and intermedia agenda setting: An analysis of traditional, partisan, and emerging online U.S. News. *J. Mass Commun. Q.* **94**, 1031–1055 (2016).
- 34 I. Rogstad, Is Twitter just rehashing? Intermedia agenda setting between Twitter and mainstream media. *J. Inf. Technol. Polit.* **13**, 142–158 (2016).
- 35 M. Gruszczynski, M. W. Wagner, Information flow in the 21st century: The dynamics of agenda-uptake. *Mass Commun. Soc.* **20**, 378–402 (2017).
- 36 V. Bakir, Policy Agenda Setting and Risk Communication: Greenpeace, Shell, and Issues of Trust. *Int. J. Press/Polit.* **11**, 67–88 (2006).
- 37 S. B. Pralle, Agenda-setting and climate change. *Env. Polit.* **18**, 781–799 (2009).
- 38 W. Lippmann, *Public Opinion* (Free Press, New York, 1922).
- 39 G. Tuchman, *Making News: A Study in the Construction of Reality* (Free Press, New York, 1978).
- 40 G. Wolfsfeld, *Making Sense of Media and Politics: Five Principles in Political Communication* (Routledge, New York, 2011).
- 41 B. Obama, *Presidential Memorandum—Creating a Federal Strategy to Promote the Health of Honey Bees and Other Pollinators* (White House Office of the Press Secretary, Washington, DC, 2014).