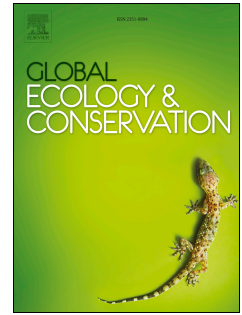


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Can we really predict a catastrophic worldwide decline of entomofauna and its drivers?

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1 **Can we really predict a catastrophic worldwide decline of entomofauna and its drivers?**

2

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13 A recent paper by Sánchez-Bayo & Wyckhuys (2019; hereafter S&W) reviewed the drivers and  
14 declining rates of insects worldwide, pointing to the global extinction of 40% of insects within the  
15 next few decades. Although the authors made a great effort to review the literature based on long-  
16 term insect surveys in different geographical regions and taxa, the conclusions of this study should  
17 be taken with caution. The biased methods and flawed analyses used by S&W lead to unsupported  
18 conclusions on the extinction of vast numbers of insect species in the near future. The results of  
19 S&W received short-term attention in the global media, but we believe this might undermine the  
20 credibility of insect conservation efforts, environmental sciences in general, and even the peer  
21 review process.

22 As partly pointed out by other authors (Komonen *et al.*, 2019; Thomas *et al.*, 2019; Wagner, 2019),  
23 caution is needed when reading S&W, given the number of limitations in the data used, statistical  
24 analyses and interpretation of results. The bias in the paper starts with the collection of data itself,  
25 which is biased in search terms used, geographical coverage and study focus. To quantify the

26 proportion of declining species, S&W only considered papers reporting declining trends in insect  
27 abundance, as revealed by their choice of search terms (Komonen *et al.*, 2019; Wagner, 2019). It is  
28 known that, even if outweighed by losers, there are also species that increased in abundance  
29 (Powney *et al.*, 2019). In addition, although the study makes assumptions for the worldwide decline  
30 in insect biodiversity, the selected surveys were mostly limited to North America and Europe  
31 (Wagner, 2019). Only 3 studies out of 73 had been done in tropical areas and even though they  
32 recognise this flaw, S&W still state that “insect declines appear to be similar in tropical and  
33 temperate regions of the world”. Finally, it seems that most studies selected by S&W focused on the  
34 consequences of agricultural intensification, including the use of fertilisers and/or pesticides.  
35 Hence, it is impossible to know if the trends found are due to this bias (Wagner *et al.*, 2019).

36 The statistical methodology by S&W also presents numerous flaws. To start with, the authors  
37 state that “conservation status of individual species follows the IUCN classification criteria”, but  
38 that is not true (see also Komonen *et al.*, 2019 for other problems in the application of the IUCN  
39 criteria). Their criteria make no reference to the timescale of the decline which should be of 10  
40 years or three generations, whichever is the longer. Also, the threshold used for critically  
41 endangered species (75%) is found nowhere in the IUCN guidelines, it should be either 80 or 90%,  
42 the latter only if the causes are reversible, understood and ceased. Contrary to what is stated, they  
43 have not performed a meta-analysis, but improperly used vote-counting. As performed, vote-  
44 counting is not informative, as it might simply reflect the past interests of researchers. Some claims,  
45 such as “About half of Coleoptera and Lepidoptera species (both moths and butterflies) are  
46 declining at a faster rate than the annual average”, are not informative at all. When following a  
47 normal distribution, half of the observations should naturally fall under the average value.

48 The end result of S&W is a biased, poorly supported message. The authors go as far as  
49 claiming that some of their supporting papers back up an apparently preconceived idea that the most  
50 important factor contributing to insect losses is agriculture intensification connected with pesticide

51 use, downplaying other factors such as habitat loss, fragmentation, invasive species or climate  
52 change (Wagner, 2019). In reality, few if any of the studies tested the drivers of decline, including  
53 agriculture intensification, only mentioning them as possible, unquantified, causes (e.g. Hallmann *et*  
54 *al.*, 2017). S&W comes across as cherry-picking or just misrepresentation of the sources. This bias  
55 would be almost understandable considering the great effort it would take to correctly tackle such a  
56 topic, but discredited literature can undermine future conservation efforts by painting scholars as  
57 fearmongers.

58 There is plenty of data and anecdotal evidence reflecting the extinction risk for numerous insect  
59 species and their declining abundances (Leather, 2018; Janzen & Hallwachs, 2019; Powney *et al.*,  
60 2019). Such evidence includes thousands of species assessed as threatened in the IUCN Red List.  
61 But the global decline is still unquantified, and we support previous calls for more evidence, not of  
62 the known decline, but of its magnitude and drivers (Leather, 2018; Habel *et al.*, 2018; Thomas *et*  
63 *al.*, 2019; Wagner, 2019). There are many better ways to reach the goals of S&W. These include  
64 searching for an unbiased and global representation of the problem in the literature, using only  
65 comparable data and taking advantage of existing raw data (e.g. the PREDICTS:  
66 <https://www.predicts.org.uk/> and BioTIME: <http://biotime.st-andrews.ac.uk/> databases), as well as  
67 using reliable meta-analysis tools and interpreting any results without preconceived notions on the  
68 importance of multiple factors causing insect decline. But fundamentally, this study underlines the  
69 lack of data on species abundances across space and time, i.e., the Prestonian Shortfall (Cardoso *et*  
70 *al.*, 2011). Only with proper data and analyses can one derive any conclusions regarding a future  
71 insect and consequent ecosystems apocalypse.

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