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EU POLLINATOR MONITORING SCHEME: A SCIENCE-POLICY CO-DESIGN PROCESS

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RESPONSE TO KRAHNER ET AL. (2025)

We would like to thank Krahner et al. (2025) for opening a discussion around the role of scientific evidence in meeting the policy requirements of the EU Pollinator Monitoring Scheme (EU PoMS 2025). The authors query the rationale for excluding pan traps as one of the core methods for EU PoMS, and do so from a scientific and technical perspective. However, the key point here is that the development of the scheme is a long-term co-design process between scientists and policy makers to fulfil a very specific policy requirement at national and continental levels. This process, including its reporting, is therefore quite different from a traditional evidence-based scientific process. Here we outline the context of the scheme, the process by which methods were chosen, and why pan traps are not an appropriate method within this particular policy context.

It is widely accepted across the scientific community that all sampling methods for insects have advantages and limitations (e.g. Westphal et al. 2008). No single method is ideal and the essential challenge is always to match the methods to the application. In this case, the EU Pollinators Initiative Action 1 (revised in the EU Pollinators Initiative 2023) which states: "The Commission and Member States should finalise the development and testing of a standardised methodology for an EU pollinator monitoring scheme (EU PoMS). The methodology will ensure delivery of annual datasets on the abundance and diversity of pollinator species, with adequate statistical power to assess whether the decline of pollinators has been reversed both at EU and national level. Once the methodology is available, Member States should deploy the scheme on the ground". To achieve this aim, the European Commission established the STING (Science and Technology for Pollinating Insects 2025) expert group in 2019 to provide scientific support for the design, refinement, and ultimately the implementation of EU PoMS.

STING membership has included more than 50 leading international experts in pollinator ecology and taxonomy, monitoring scheme design and methods, biodiversity metrics and indicators, citizen science, and data management. The experts come from 17 countries, covering the academic, NGO, and policy communities with extensive long-term experience in biodiversity monitoring. Both of the STING reports (Potts et al. 2021, 2024) went through extensive peer review by both independent experts and representatives of Member States (Science and Technology for Pollinating Insects 2025).

The key policy requirements set out by the European Commission for EU PoMS include: a set of standardised and robust methods for surveying species abundance of pollinators; data to be collected annually in representative ecosystems; and trends assessed every 6 years to reliably be able to detect changes. The critical points to highlight here are (i) the requirement for high quality and reliable abundance data, and (ii) the ability of an indicator to be able to reliably demonstrate trends to inform policy. While pan traps have many applications for carrying out surveys, they fail to meet both of these requirements, and here we explain why.

First of all, pan traps are an attraction-based method using coloured pans to attract and trap flying insects, and therefore can not provide a direct measure of pollinator abundance (a core requirement of EU PoMS). Further, they are highly biased in their attractivity to different taxa. For instance, they may be useful for assessing the species richness of bee communities, however, for some bee groups such as bumblebees, they can be relatively ineffective, and they also perform very poorly for both hoverflies and butterflies (Potts et al. 2024, section 2). A wide range of potential survey methods were critically assessed in the first STING report (Potts et al. 2021, section 4) where these limitations were identified. At this stage, it was concluded that while pan traps could provide insights into bee diversity, and less so for other taxa, they could not provide direct abundance measures. Therefore, the use of standardised transect walks were deemed to be the best method to provide species abundance data for a range of pollinators, including bees (Potts et al. 2024, section 2).

Secondly, given that the primary purpose of EU PoMS is to inform policy, specifically around the effectiveness of restoration efforts to halt and reverse the decline of pollinators, pan traps pose a high risk of providing a perverse policy signal. The reason why is grounded on strong empirical evidence (Potts et al. 2024, section 2.2). The key issue here is that pan trap catches do not respond in a linear way to local floral context, as the relative attractiveness of the pans compared to the background flowers is not constant. At low floral densities, the number of bees caught increases with flower cover, however beyond a cover of around 3 flowers/m^2, the number of bees decreases with increasing flower cover (Figure 2.2.2, Potts et al. 2024; see also Kuhlman et al. 2021; Westerberg et al. 2021). On this basis alone it excludes pan traps from being able to provide robust, reliable and high quality species abundance data. This is entirely consistent with Krahner et al. (2024), who state, based on their own analysis "Often studies did not find any correlation between the floral environment and bee samples. Reported correlations varied markedly across studies, even within groups of studies applying a similar method or analysing a similar group of bees". This non-linear response could lead to a situation where a small amount of local restoration (e.g. a few wild flower margins) leads to a modest increase in flower cover which results in a large increase in the abundance of bees caught in pan traps (due to pans being relatively more attractive than the local flora). In exactly the same situation, if there was a substantial amount of local restoration (e.g. extensive conversion of arable to flower meadow) then there would only be a small increase in the abundance, or likely even a decrease, of bees caught in pan traps (due to the local flora attracting bees away from the pans). A possible conclusion would be that substantial flower restoration efforts result in losses of pollinators. This clearly calls into question the utility of pan traps to inform the policy need to test whether a decline of pollinators has been reversed or not (EU Pollinators Initiative 2023).

Krahner et al. (2025) question the theoretical background and "strong assumptions" of our approach, which we clarify here. Our concept was developed on the basis of the density-dependence of flower visitations, as suggested by Rathcke (1983), observed, e.g. by Ghazoul (2006), and modelled, e.g. by Essenberg (2012). The basic principle is that increasing flower densities decrease distances among flowers and thus foraging times leading to increased flower visitations, while on the other hand it also decreases the pollinator-to-flower ratio, ultimately causing a decline in flower visits. Since both mechanisms are dependent on flower densities (the effect of adding flowers on shortening distances and foraging times is much stronger at low compared to high flower densities) this results in an initial increase, peak, and then decrease of flower visits with increasing flower densities. We apply this approach in analogy to pan traps and the only assumption we are making is that these mechanisms also apply to pan traps (which by design mimic flowers). The difference between abundance estimates by pan traps and transect walks comes from the difference in the activity of the actor. While for pan traps, the number of catches depends on the activity of the pollinators and thus likely underlies the above mentioned dependence on flower densities, abundance estimates based on transects depend on the activity of the observer, usually covering larger distances and thus also reflecting flower density conditions. With this, transect walks should come closer to assessing 'true' pollinator abundance responses to increasing flower densities. Here, we assume that such responses follow a logistic growth model where the limiting effects of flower resources diminishes while those of other constraints increase as the carrying capacity of a habitat patch is reached (reviewed in Chapman & Byron 2018).

Krahner et al. (2025) also criticise the way we collated and selected our data and question their sufficiency in terms of quantity and quality. To collate data, we started with the SPRING (Settele et al. 2024) consortium and a 'snow-ball' system asking for willingness to share data and for structured metadata about sampling design covering, e.g. number of sites and locations, spatio-temporal replication, method (pan trap, transect), covered species groups, taxonomic level of identification, or method of local flower surveys, in addition to geographic area, data holder, data access conditions, and related publications. As reported in Potts et al. (2024, section 2.2), our exclusion criteria were: (i) flower resources were provided in terms of percentage cover instead of density (flower unit per m^2), and (ii) low pollinator abundance, and in particular low variation across the samples. The critique of Krahner (2025) et al. on missing access to unpublished data is reasonable, but unfortunately, STING cannot publish data that have been kindly provided by other experts to support the work of this science-policy group. Relevant methodological information has been provided by referring to the respective publications where available, which should not be confused with free access to the raw data – which is within the frame of the data policy of the individual data provider. More detailed methodological information on the unpublished data sets can be requested from the data providers listed in the acknowledgements of Potts et al. (2024). In contrast to the view of Krahner et al. (2025) that "quantity of [our] data seems to be insufficient", which they raise without any justification, we are confident that a total of more than 1,500 data points (between 350 and 670 per analysis) from 13 studies across five European countries is very comprehensive (benchmarked against similar studies) and allows for robust conclusions.

We find some of the wording from Krahner et al. (2025) unfounded, for example "data manipulation before analysis raises serious questions", in the context of pooling data at the habitat patch level and data standardisation for comparability. The impact of flower densities acts within the foraging range of the pollinators. Pooling pollinator and flower data across a habitat patch is thus more likely to match these ranges. In contrast, assessing the impacts of flower densities in the direct vicinity of the local pan traps does not reflect foraging ranges and, moreover, may introduce problems of pseudo-replication across multiple local pan traps within a habitat patch. In addition, linking local small-scale flower survey plots to transects covering larger areas is not possible without pooling. We agree that the way we standardised the data to increase comparability among the different studies might have missed some potential differences in the sampling design. However, the key question we addressed was the reliability of abundance estimates from pan traps in comparison to transect walks, and not small methodological differences among studies. We build our confidence in our approach and results on two facts. First, our results match with theoretical expectations. Second, the distribution of the data from the different studies (colour-coded in Figure 2.2.2 in Potts et al. 2024) shows a large overlap along the flower density gradients and no indication of a potential bias caused by systematic differences among the studies.

A final consideration, in addition to pan traps being unable to deliver reliable species abundance data and risk providing a perverse policy signal, is that pan traps have other limitations. First, pan traps are an unselective method that tends to kill high numbers of particular species, as well as non-negligible numbers of not targeted taxa (Portman et al. 2020) and their long-term effect on pollinator populations is unknown. In fact, given that the ambition of EU PoMS is to maximise the potential of citizen science, it is increasingly recognised that lethal methods are less favoured by citizen scientists and can be a barrier to recruitment (Potts et al. 2024, section 2.7). Secondly, because sites need to be visited twice instead of once (as for transects) and pan trap samples need to be processed in the laboratory, pan trapping is a relatively costly method for surveying pollinators compared to transect walks (see Potts et al. 2021, section 5.5). We acknowledge from a purely scientific perspective, the use of a combination of methods (such as transects plus pan traps) could yield a greater number of samples and species (e.g. Westphal et al. 2008; Lezzeri et al. 2024), but the unambiguous results in terms of abundance between both methods does not allow for a clear identification of changes in pollinator trends and might lead to 'cherry-picking'. The EU PoMS design is a science-policy co-design process where the science must be robust and meet the political needs, rather than the final design meeting only researcher preferences.

To conclude, monitoring must avoid systematic biases, and the use of pan traps risks giving a perverse signal when restoration enhances floral resources, while the pan trap signal shows local declines in pollinators. We recognise, pan trapping is an observer-independent methodology that allows for the possibility to sample multiple locations simultaneously, and pan traps may be useful for certain sorts of analyses (e.g. bee inventories, see Potts et al. 2024 section 5.1), however, they are not suitable for assessing pollinator recovery of a time series, in the context of the stated objectives of EU PoMS and the EU Pollinators Initiative.

AUTHOR CONTRIBUTION

All authors contributed to the concept, writing and approval of the publication. We also recognise the important contributions of all the other STING experts to the wider science-policy process for EU PoMS (see Potts et al. 2021, 2024 for full list of experts).

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

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