

Scientific Life

Authorship Protocols Must Change to Credit Citizen Scientists

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The sociopolitical nature of research is changing and so must our protocols for authorship. Citizen scientists are often excluded from authorship because they cannot meet rigid journal criteria. To address this, we propose a new concept: allowing nonprofessional scientists to be credited as authors under a collective identity ('group coauthorship').

Increasingly, scientific journals impose rigid rules to identify who has contributed to a particular article and how they have done so. Only specific types of contributions constitute grounds for authorship. That tightening-up has been driven by a desire for transparency and a suspicion that ambiguity about author roles may facilitate undesirable practices such as incorporating people who do not warrant inclusion and disguising participation by individuals or organizations with undisclosed conflicts of interest [1]. However, that laudable aim has created a set of regulations that make it difficult to recognize the efforts of nontraditional contributors. This situation is especially problematic in studies for which data collection and/or study design depend on citizen scientists: members of the public who collaborate with professional scientists.

Citizen science has grown at a spectacular rate over recent years. This growth has been driven by changing sociopolitical environments (e.g., the recogni-

tion of Traditional Ecological Knowledge, increased focus on the broader impacts of research) but also by technological advances (e.g., the internet, GPS-enabled smartphones) that allow people to ask novel questions and collect data at unprecedented spatial and temporal scales [2]. Members of the general public have become pivotal contributors to research, resulting in thousands of scientific publications [3] and measurable conservation impacts [4]. How should we credit that input? The answer depends on the situation, raising nuances incompatible with current authorship regulations.

Most scientific journals adopt or reference the authorship guidelines set by the International Committee of Medical Journal Editors (Box 1) [5]. For example, the *Nature*, *PLoS*, and *Science* families of journals all follow these recommendations. Nevertheless, studies demonstrate that individual scientists' viewpoints vary widely in what they consider the minimum requirement for authorship (e.g. [6]).

Unfortunately, the ICMJE authorship recommendations are not adequate for research efforts that depend on citizen scientists, who are unlikely to have experience researching, writing, or publishing scientific manuscripts. Consider the increasingly common situation in natural science research, where citizen scientists provide all or a significant portion of the data (e.g., species occurrence records) through platforms such as iNaturalist. Scientists may be able to publish a discovery only because of these data. The citizen scientists clearly meet ICMJE authorship recommendation 1, could provide final approval of a manuscript as per recommendation 3, but are likely to lack the training, time, and experience to meet recommendation 2 or 4. Thus, according to ICMJE recommendations, they

should not be listed as authors. However, this undervalues the role of citizen scientists, and is strategically unwise if researchers hope to maintain credibility and collaborate with groups in the future.

To resolve this situation, we suggest the standardized adoption of 'group coauthorship' for cohorts of nonprofessional scientists. Under this scheme, the author list can include both individually named authors who meet standard authorship recommendations and an identifiable group whose members have made pivotal research contributions but may not meet all standard authorship requirements (Box 2). Several of us have published with group coauthors and received positive feedback. Further, this idea has been implemented previously [7], although not formalized as a specific authorship category.

This concept builds on existing authorship and article-indexing practices for group authorships in which a research group name is listed as the sole author or in addition to individually named authors [8]. In the former case, the individual authors are typically listed elsewhere in the publication. In the latter approach, individual authors are typically listed in the author byline, followed by a phrase like '...on behalf of the XXX Group'. A well-known example comes from the release of the human genome sequence (International Human Genome Sequencing Consortium [9]). Group authorships have been used since 1841 [10], with increasing frequency from 1940 (reflecting the growth of multi-institution medical trials) [8]. The ICMJE has recommendations about group authorships [5], as do some journals (e.g., the *PLoS* family of journals; <https://journals.plos.org/plosone/s/authorship>). By now, most citation



Box 1. The ICMJE [5] Recommends That All Authors Meet the Following Four Criteria

1. Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND
2. Drafting the work or revising it critically for important intellectual content; AND
3. Final approval of the version to be published; AND
4. Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

In addition to being accountable for the parts of the work he or she has done, an author should be able to identify which coauthors are responsible for specific other parts of the work.

indexing and tracking issues have been solved [8,10].

As examples of the aforementioned problems, we summarize our experiences across disparate research efforts involving collaborations with members of the public who were credited under group coauthorships. These groups were essential to the research and resulting publications, but the group members lacked enough scientific training to actively participate in manuscript publication. All individuals opted into being group coauthors and approved the final version to be published (which may be impractical for large groups). We provide these case studies to highlight the breadth of situations in which unintentional discrimination occurs as a result of rigid authorship protocols.

Case Study 1: Studying Species Distributions across Southern California, USA via an Online Citizen Science Platform

To document gastropod distributions in Southern California, J.E.V. and the Natural History Museum of Los Angeles County launched a citizen science project called SLIME (Snails and slugs Living in Metropolitan Environments) in 2015 on the online platform iNaturalist (<http://www.inaturalist.org/projects/slime>). Because of urban sprawl and inaccessible private property in the Greater Los Angeles Area, citizen science can be especially

effective at generating species occurrence data [11–13]. As of late 2019, SLIME has approximately 2200 contributors and 14 000 observations. Project outcomes were summarized in two publications, providing the first evidence of several introduced gastropod species in the state of California [12] and the USA [13]. In one publication [12], four citizen scientists who provided specimens were listed as coauthors alongside five researchers. All citizen scientists provided feedback on the manuscript and the editor of *The Journal of Natural History* allowed their inclusion as coauthors.

In the second article [13], published in *The American Malacological Bulletin*, the author list includes three researchers and two cohorts of citizen scientists: a 14-person group of SLIME contributors and a family who hosted a Malaise insect trap wherein snails were collected [11]. The coauthor byline reads 'and citizen science participants in SLIME and BioSCAN'. The individuals and family are named in the author affiliation. However, while the group coauthorship byline is present in the published article, it is excluded from the article's citation in BioOne (which published Vendetti et al. [13]) and Google Scholar, but is included in Web of Science. Such inconsistency undermines the recognition of citizen science group coauthors and shows the need for standardized protocols adopted by all publishers.

Case Study 2: Conservation Research with Indigenous Traditional Owners in Tropical Australia

To mitigate the impact of invasive cane toads on apex predators in northern Australia, we (G.W.-F. and R.S.) trialed a novel conservation intervention called Conditioned Taste Aversion [14]. We worked closely with the Balanggarra Rangers (representatives of the indigenous traditional owners of that region). This kind of arrangement is increasingly common in Australia. Our research teams comprised equal numbers of scientists and Balanggarra Rangers and without their participation the study would have failed [15]. However, acknowledging that critical role was not simple. Many Balanggarra people contributed to the study – some frequently, others occasionally – and to have selected a few for authorship would have been arbitrary and culturally insensitive. Proud of their collective cultural identity, the Rangers were delighted when we added the 'Balanggarra Rangers' to the authorship of two papers [14,15]. Appreciation for the scientific value of Traditional Ecological Knowledge and skills is rapidly growing [15], but exploitative historical practices render engagement between science and First Nations peoples particularly sensitive.

The Balanggarra team unquestionably warranted group coauthorship, but adding 'the Balanggarra Rangers' to the authorship list was difficult. We had to negotiate with editors and editorial staff to achieve that result with *Biology Letters* and *Conservation Letters*. Even then, the group name was abbreviated in citations as 'B. Rangers', an unintended (but culturally insensitive) consequence of citation software. In other publications, we were unable to include the Rangers as coauthors; for example, in the journal

Box 2. Recommendations for Using, Listing, Citing, and Indexing Group Coauthors

We recommend the following approaches to standardize treatment of group coauthorships.

- Group coauthorship should be used in situations in which a group cannot meet standard ICMJE and/or journal-specific authorship regulations but has made contributions ‘essential to project success’. Data acquisition normally would not solely qualify a person for authorship, but we suggest making this permissible in the context of citizen science when the research project exists only due to the data collected by citizen scientists. In essence, individuals in the group receive generic credit rather than specific credit that could advance their careers.
- Group coauthorship should be used only for established groups (e.g., the ‘Balanggarra Rangers’, ‘SLIME participants’, ‘the Foldit players’ [7]), not for amorphous groups who engage with generic surveys (e.g., consumer market research), or medical studies (both of which are best recognized in the Acknowledgments). Importantly, the group in question should express a desire for authorship.
- Group coauthor names should be as short as possible.
- Group coauthor names should be listed in full in the author byline at all times (e.g., ‘Balanggarra Rangers’, not ‘B. Rangers’), even in journals that usually abbreviate first names.
- The complete name of the group coauthor should be used when indexing and citing, consistent with protocols for ‘group authors’.
- Author order remains at the discretion of the whole authorship team. The group coauthor could be listed as first, middle, or last author.
- Named authors and members of the group can decide whether to list the group members’ names in the manuscript. If so, these should be somewhere other than the author byline; for large groups, the supplements or appendices may be appropriate.

Ecosphere (group authors not allowed) and *The Conversation* (official academic affiliation required). Failing to recognize indigenous traditional owners because they cannot qualify for academic authorship under ICMJE rules (despite playing a pivotal role in the research) could be perceived as discriminatory.

The general point is clear: one subculture (professional scientists) has created authorship rules that aim to prevent ethical breaches, but their often-narrow scope can marginalize important contributors (e.g., citizen scientists, indigenous organizations). To address that problem, we need to: (i) expand the qualifications for authorship to include people who are not professional researchers; and (ii) establish protocols for identifying group coauthors, (as we have outlined). Banning group coauthorship does not achieve the aims of codifying authorship rules; that is, nominating a group as authors will not allow individuals to cheat by claiming undeserved authorship

(because they will not be listed individually), and it can illuminate any commercial conflicts of interest (by drawing attention to the organization to which contributors belong). Any ambiguity can be addressed by including a full list of group membership in each paper, unless the group chooses otherwise.

With a little flexibility about authorship criteria, we can achieve two critical aims: deter scientific fraud and appropriately recognize the contributions of everyone who played a major role in the research. The nature of research is changing, with increasing participation by nonprofessionals. Our rules for authorship need to change to recognize this evolving social dimension of scientific research.

Author Contributions

J.E.V. and G.W-F. managed the projects in case studies. R.S., G.W-F., and G.B.P. conceptualized the manuscript. All authors contributed to writing the

manuscript (in order R.S., G.B.P., G.W-F., J.E.V.). R.S. provided overarching management of manuscript production. G.W-F. and G.B.P. contributed equally as co-first authors.

Data and Materials Availability

All research mentioned has been published and is available from respective outlets.

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