ACSA Publications Listing
No. 14 – March 2021
List moderator: Amy Slocombe

Journal Articles - *Conference Proceedings Articles* *Dissertations* - *Books & Chapters*

From the moderator

Thank you to everyone who contributed to this issue of the ACSA Publications Listing.

The ACSA Publication Listing is a quarterly electronic listing of publications in the field of citizen science within the Australian community. The listing is intended to share information with those interested in the Australian citizen science community.

If you are interested in obtaining a copy of one of the papers below, you can email the lead author who may send you a copy at their discretion.

Amy Slocombe

Abstracts of recently published journal articles

Four new species of parasitoid wasp (Hymenoptera: Braconidae) described through a citizen science partnership with schools in regional South Australia

Fagan-Jeffries, E.P[1], Austin, A.D[1]

[1] Australian Centre for Evolutionary Biology & Biodiversity and School of Biological Sciences, University of Adelaide, Adelaide, South Australia, 5005, Australia

Involving the community in taxonomic research has the potential to increase the awareness, appreciation and value of taxonomy in the public sphere. We report here on a trial citizen science project, Insect Investigators, which partners taxonomists with school students to monitor Malaise traps and prioritise the description of new species collected. In this initial trial, four schools in regional South Australia participated in the program and all collected new species of the braconid subfamily Microgastrinae (Hymenoptera: Braconidae). These four species are here described as new, with the names being chosen in collaboration with the participating school students: Choeras ramcomarmorata Fagan-Jeffries & Austin sp. nov.,

Glyptapanteles drioplanetus Fagan-Jeffries & Austin sp. nov., Dolichogenidea franklinharbourensis Fagan-Jeffries & Austin sp. nov. and Miropotes waikerieyeties Fagan-Jeffries & Austin sp. nov. All four species are diagnosed against the known members of the genera from Australia, New Zealand, Fiji, Samoa and Papua New Guinea, and images and COI DNA barcodes are provided of the holotypes. Students had positive feedback about their experiences of the program, and there is significant potential for it to be expanded and used as a means to connect communities with taxonomic science.

Published March 2021 in *Zootaxa* Vol 4949:1, 79-101
doi: https://doi.org/10.11646/zootaxa.4949.1.4

A visualisation tool for citizen-science marine debris big data

Clark, G.F[1], Gacutan, J[1], Lawther, R[2], Johnston, E.L[1], Tait, H3 & Bednarz, T[2]

1 School of Biological, Earth and Environmental Sciences, University of New South Wales, Sydney, New South Wales, Australia
2 EPICentre, UNSW Art & Design, Paddington, New South Wales, Australia
3 Tangaroa Foundation, Margaret River, Western Australia Australia

We describe the design and structure of a web-based visualization tool for an Australian marine debris database and its application in environmental research, management and science communication. We give examples of its use in generating hypotheses regarding processes driving the distribution of marine debris, identifying source reduction opportunities and communicating science to the public and stakeholders. We suggest this as a model for utilizing other latent environmental data sets, enabling users to implement the five 'source-to-sea' steps to characterize, engage, diagnose, design, act and adapt when addressing leading environmental concerns.

Published March 2021 in *Water International* Vol 46:2, 211-223
doi: https://doi.org/10.1080/02508060.2021.1888495

Potential and pitfalls of citizen science with children: Reflections on Pollinators in the Playground project

Prendergast, K[1], Vanderstock, A[2], Neilly, H[3], Ross, C[4], Pirotta, V[5], Tegart, P[6]

1 School of Molecular and Life Sciences, Curtin University, Bentley, Western Australia, 6102 Australia
2 School of Life and Environmental Sciences, The University of Sydney, Sydney, New South Wales, Australia
3 Australian Landscape Trust, Renmark, South Australia, Australia
4 Fenner School of Environment and Society, Australian National University, Canberra, Australian Capital Territory, Australia
5 Department of Biological Sciences, Macquarie University, Sydney, New South Wales, Australia
6 Australian Citizen Science Association, Sydney, New South Wales, Australia

Engaging school-age children in activities involving 'real-world' science and interacting with scientific researchers can promote an interest in appreciating and understanding the natural

world and the scientific method. Here, we describe a project involving five female early-career and PhD researchers who facilitated a citizen science project with school-age children. Under the guidance of the researchers, across five schools, children created artificial flowers and installed them on school ovals. Over repeated 10-min observations, students recorded how colour (yellow vs. blue) and configuration (isolated, clumped adjacent, clumped mixed colour and clumped single colour) influenced how many and what taxa of insects visited. Here, we reflect on what we were able to achieve including creating a simple, fun, cost-effective project; anecdotal student interest in insects, and positive female STEM role models. We also acknowledge constraints and shortcomings, including set curricula resulting in suboptimal season for pollinator studies; confounding of results due to children's observations; and being unable to verify the data. We offer recommendations for more robust projects in future, which include collecting specimens to verify results, and measuring learning outcomes. If these recommendations are met, researcher–student projects can engage children in conducting scientific experiments with applications for home and school garden management.

Published March 2021 in *Austral Ecology Special Issue: Insect Traits and Ecology*
doi: https://doi.org/10.1111/aec.13031

Biodiversity citizen science: Outcomes for the participating citizens

Peter, M[1,2], Diekötter, T[2], Höffler, T[3], Kremerk K[4]

1 Department of Biology Education, IPN - Leibniz Institute for Science and Mathematics Education, Kiel, Germany
2 Department for Landscape Ecology, Institute for Natural Resource Conservation, Kiel University, Kiel, Germany
3 IPN - Leibniz Institute for Science and Mathematics Education, Kiel, Germany
4 Biology Education, IDN - Institute for Science Education, Leibniz University Hannover, Hannover, Germany

Citizen science (CS) is regarded as a promising format in environmental and sustainability education as well as in science education. CS projects often assume that participation in the project influences, for example, participants' knowledge or behaviour.
We investigated whether and to what extent biodiversity citizen science (BDCS) projects, from the participants' self-reported perspective, achieve the following six participant outcomes: (a) content, process and nature of science knowledge, (b) skills of science inquiry, (c) self-efficacy for science and the environment, (d) interest in science and the environment, (e) motivation for science and the environment and (f) behaviour towards the environment. For this purpose, we conducted an online survey of 1,160 CS participants across 63 BDCS projects in Europe, Australia and New Zealand. Our survey was aimed at adults participating in CS voluntarily.
Survey respondents reported positive changes in all six categories. The most notable result across projects was that self-reported increases in knowledge, self-efficacy, interest and motivation were found to be more pronounced when regarding the environment rather than science. Perceived gains in data collection skills were reported to be higher than gains in skills not directly connected to data collection. Reported behaviour changes primarily concerned communication activities, to a lesser degree also gardening activities, and finally more general environmental behaviour.

In addition to these six participant outcomes, respondents mentioned a variety of other positive and negative outcomes, for example, health and well-being, enjoyment, a sense of satisfaction, an increased connection to people and nature but also a more pessimistic view regarding the future of the environment.
We conclude that BDCS projects could have a high potential for environmental and sustainability education as well as science education. Further research should investigate individual participant outcomes in more depth and should focus on the factors that influence these participant outcomes. Moreover, exploring the perspectives of both project participants and project coordinators would be valuable. In this way, it would be possible to improve the development and design of CS projects. As a result, BDCS projects could more effectively achieve outcomes for the participants, for science and for biodiversity.

Published March 2021 in People and Nature 2: 294-311
doi: https://doi.org/10.1002/pan3.10193

Optimising monitoring for trend detection after 16 years of woodland-bird surveys

Prowse, T.A.A[1], O'Connor, P.J[2], Collard, S.J[2], Peters, K.J[3], Possingham, H.P[4,5]

[1] School of Mathematical Sciences, The University of Adelaide, Adelaide, SA, Australia
[2] Centre for Global Food and Resources, The University of Adelaide, Adelaide, SA, Australia
[3] Natural Resources Adelaide and Mount Lofty Ranges, Adelaide, SA, Australia
[4] The Nature Conservancy, South Brisbane, Qld, Australia
[5] School of Biological Sciences, The University of Queensland, St Lucia, Qld, Australia

Long-term biodiversity monitoring programs provide important information about species' trajectories and broader environmental change. Often constrained by funding and organisational capability and commitment, monitoring programs need to be optimised to maximise ecological and economic efficiencies, as part of sound adaptive management.
The monitoring design requirements for detecting biodiversity trends, across assemblages of species with different traits, can be informed by historical datasets. Using data from a landscape-scale (c. 2,500 km2) bird monitoring program encompassing 151 sites visited three times annually over 16 years, we used resampling to simulate different monitoring designs. We quantified the capacity of modified monitoring regimes to detect population trends for 65 bird species with different densities, detectabilities and specialisations.
The majority (58%) of species exhibited a significant decline in relative abundance, with the ability to detect trends proportional to the length of the time series used for analysis. The percentage of trends detected decreased as survey sites or sessions were dropped from the monitoring dataset. Statistically significant trends remained undetected for an additional 2.5 species for every 10% of sites excluded randomly from the program. As monitoring effort was reduced, the precision of trend estimates for rare species was particularly compromised. Conducting bird surveys every second year would produce better results than an equivalent reduction in effort achieved by surveying only half the sites each year, but could compromise the sustainability of the program. If the number of survey sites were reduced, trend detection would be optimised by retaining the spatial extent of the surveys (i.e. by dropping sites from well-surveyed regions rather than excluding outlying, isolated sites), but the cost savings of this approach would be small.
Synthesis and applications. Reduced monitoring effort will compromise trend detection for rare species or species that are difficult to observe, and declining species that will soon become rare. Consequently, monitoring effort that is considered ‘surplus’ today could provide critical data for detecting species-level trends and prioritising conservation

interventions in the future. Further, sampling efficiencies are not all-important; we must also consider the impacts of survey design modification on the social and political sustainability of existing monitoring programs.

Published March 2021 in *Journal of Applied Ecology* 00: 1– 11
doi: https://doi.org/10.1111/1365-2664.13860

Citizen Science as Democratic Innovation That Renews Environmental Monitoring and Assessment for the Sustainable Development Goals in Rural Areas

Ferrari, C.A[1], Jönsson, M[2], Gebrehiwot, S, G[3], Chiwona-Karltun, L[1], Mark-Herbert, C[4] , Manuschevich, D[5], Powell, N[6,7], Do, T[6], Bishop, K[8] and Hilding-Rydevik, T[9]

1 Department of Urban and Rural Development, Swedish University of Agricultural Sciences (SLU), 750 07 Uppsala, Sweden
2 Swedish Species Information Centre, Swedish University of Agricultural Sciences (SLU), 750 07 Uppsala, Sweden
3 Ethiopian Institute of Water Resources, Addis Ababa University, 15046 Addis Ababa, Ethiopia
4 Department of Forest Economics, Swedish University of Agricultural Sciences (SLU), 750 07 Uppsala, Sweden
5 Department of Geography, University of Chile, 8331051 Santiago, Chile
6 Sustainability Learning and Research Centre (SWEDESD), Uppsala University, 752 37 Uppsala, Sweden
7 Sustainability Research Centre, University of the Sunshine Coast (USC), 4558 Queensland, Australia
8 Department of Aquatic Sciences and Assessment, Swedish University of Agricultural Sciences (SLU), 750 07 Uppsala, Sweden
9 Swedish Biodiversity Center, Swedish University of Agricultural Sciences (SLU), 750 07 Uppsala, Sweden

This commentary focuses on analyzing the potential of citizen science to address legitimacy issues in the knowledge base used to guide transformative governance in the context of the United Nation's Sustainable Development Goals (henceforth SDGs). The commentary develops two interrelated arguments for better understanding the limits of what we term "traditional" Environmental Monitoring and Assessment (EMA) as well as the potential of citizen science (CS) for strengthening the legitimacy of EMA in the local implementation of SDGs. We start by arguing that there is an urgent need for a profound renewal of traditional EMA to better implement the SDGs. Then, we present CS as a democratic innovation that provides a path to EMA renewal that incorporates, develops, and extends the role of CS in data production and use by EMA. The commentary substantiates such arguments based on current approaches to CS and traditional EMA. From this starting point, we theorize the potential of CS as a democratic innovation that can repurpose EMA as a tool for the implementation of the SDGs. With a focus on the implementation of SDG15 (Life on Land) in local contexts, the commentary presents CS as a democratic innovation for legitimate transformative governance that can affect socio-ecological transitions. We see this approach as especially appropriate to analyze the implementation of SDGs in rural settings where a specific resource nexus can create conflict-laden contexts with much potential for a renewed EMA to support transformative governance towards Agenda 2030.

Published March 2021 in Sustainability 13(5), 2762
doi: https://doi.org/10.3390/su13052762

An overview of the history, current contributions and future outlook of iNaturalist in Australia

Mesaglio, T[1,3] and Callaghan, C.T[1,2]

[1] Centre for Ecosystem Science, School of Biological, Earth and Environmental Sciences, The University of New South Wales, UNSW Sydney, NSW 2052, Australia.
[2] Evolution & Ecology Research Centre, School of Biological, Earth and Environmental Sciences, The University of New South Wales, UNSW Sydney, NSW 2052, Australia.
[3] Corresponding author. Email: thomasmesaglio@gmail.com

Citizen science initiatives and the data they produce are increasingly common in ecology, conservation and biodiversity monitoring. Although the quality of citizen science data has historically been questioned, biases can be detected and corrected for, allowing these data to become comparable in quality to professionally collected data. Consequently, citizen science is increasingly being integrated with professional science, allowing the collection of data at unprecedented spatial and temporal scales. iNaturalist is one of the most popular biodiversity citizen science platforms globally, with more than 1.4 million users having contributed over 54 million observations. Australia is the top contributing nation in the southern hemisphere, and in the top four contributing nations globally, with over 1.6 million observations of over 36 000 identified species contributed by almost 27 000 users. Despite the platform's success, there are few holistic syntheses of contributions to iNaturalist, especially for Australia. Here, we outline the history of iNaturalist from an Australian perspective, and summarise, taxonomically, temporally and spatially, Australian biodiversity data contributed to the platform. We conclude by discussing important future directions to maximise the usefulness of these data for ecological research, conservation and policy.

Published March 2021 in *Wildlife Research*
doi: https://doi.org/10.1071/WR20154

Is color data from citizen science photographs reliable for biodiversity research?

Laitly, A[1], Callaghan, C.T[1], Delhey, K[2,3], Cornwell, W.K[1]

[1] Evolution and Ecology Research Centre, School of Biological, Earth and Environmental Sciences, University of New South Wales, Sydney, NSW, Australia
[2] Max Planck Institute for Ornithology, Seewiesen, Germany
[3] School of Biological Sciences, Monash University, Clayton, Vic., Australia

Color research continuously demands better methods and larger sample sizes. Citizen science (CS) projects are producing an ever-growing geo- and time-referenced set of photographs of organisms. These datasets have the potential to make a huge contribution to color research, but the reliability of these data need to be tested before widespread implementation.
We compared the difference between color extracted from CS photographs with that of color extracted from controlled lighting conditions (i.e., the current gold standard in spectrometry) for both birds and plants. First, we tested the ability of CS photographs to quantify interspecific variability by assessing > 9,000 CS photographs of 537 Australian bird species

with controlled museum spectrometry data. Second, we tested the ability of CS photographs to quantify intraspecific variability by measuring petal color data for two plant species using seven methods/sources with varying levels of control.
For interspecific questions, we found that by averaging out variability through a large sample size, CS photographs capture a large proportion of across species variation in plumage color within the visual part of the spectrum (R2 = 0.68–0.71 for RGB space and 0.72–0.77 for CIE-LAB space). Between 12 and 14 photographs per species are necessary to achieve this averaging effect for interspecific studies. Unsurprisingly, the CS photographs taken with commercial cameras failed to capture information in the UV part of the spectrum. For intraspecific questions, decreasing levels of control increase the color variation but averaging larger sample sizes can partially mitigate this, aside from particular issues related to saturation and irregularities in light capture.
CS photographs offer a very large sample size across space and time which offers statistical power for many color research questions. This study shows that CS photographs contain data that lines up closely with controlled measurements within the visual spectrum if the sample size is large enough, highlighting the potential of CS photographs for both interspecific and intraspecific ecological or biological questions. With regard to analyzing color in CS photographs, we suggest, as a starting point, to measure multiple random points within the ROI of each photograph for both patterned and unpatterned patches and approach the recommended sample size of 12–14 photographs per species for interspecific studies. Overall, this study provides groundwork in analyzing the reliability of a novel method, which can propel the field of studying color forward.

Published March 2021 in *Ecology and Evolution* 00: 1– 13
doi: https://doi.org/10.1002/ece3.7307