ACSA Publications Listing
No. 17 – December 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

Co-created citizen science: challenging cultures and practice in scientific research

Jade Gunnell, Yaela Golumbic, Tess Hayes and Michelle Cooper

Co-created citizen science offers practical tools for implementing science communication theories by increasing public participation in scientific research, empowering communities and advancing situated scientific knowledge. However, delivering such an approach presents a number of key challenges around funding, fostering working partnerships between scientists and citizens and ensuring all stakeholders receive sufficient benefits from the process. In this essay we draw from science communication and citizen science literature to describe these challenges and discuss the opportunities that will enable co-created practices to prosper.

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Boosting soil citizen-science using Tea Bag Index method towards soil security in Australia

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Citizen science is becoming a significant contribution to large scale soil surveys. TeaComposition is a citizen science project introducing the Tea Bag Index (TBI) method to students in Australia to support research on soil decomposition using tea bags (green and rooibos). Soil microbial driven decomposition is an essential soil function that releases soil organic matter (SOM) and nutrients, i.e., soil ecosystem services. The TBI experiments enable citizens to understand this process (increasing soil connectivity) and this information is valuable for assessing urban soil conditions. With 430 TBI in-field incubations between 2017 and 2020, this project engaged more than 3200 students who tested the TBI method on more than 50 school grounds and collected soil samples for analyses of soil properties. Approximately 50% of the tea bags were recovered and mean TBI parameters were: decomposition rate (k) = 0.02 gd−1 and stabilisation factor (S) = 0.32. Soil texture, SOC and SI had the most significant relationships with TBI. Clay and Slaking Index (SI) had negative impacts on k (rs = -0.37, -0.22, $p \leq 0.05$, respectively) and SOC had a negative effect for S (rs=-0.27; $p \leq 0.05$). These results suggest a combination of high clay and SOC may be related to reduced potential for C sequestration. Regarding citizen science, this study suggests further research using a local tea brand and shorter burials. This suggestion aims to increase Australian citizen participation.

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STATE OF THE NATION: Unlocking the Academic Library: Open Access

Cathy Foley

Science mythology is replete with Eureka moments, but the reality, as any researcher will know, is that breakthroughs are built on deep foundations of work that has come before – and no single research paper holds all the evidence to solve any scientific challenge. This is why the research community collaborates, attends conferences and shares results in academic journals. But the system has reached a tipping point.

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Continental patterns in marine debris revealed by a decade of citizen science

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Anthropogenic marine debris is a persistent threat to oceans, imposing risks to ecosystems and the communities they support. Whilst an understanding of marine debris risks is steadily advancing, monitoring at spatial and temporal scales relevant to management remains limited. Citizen science projects address this shortcoming but are often critiqued on data accuracy and potential bias in sampling efforts. Here we present 10-years of Australia's largest marine debris database - the Australian Marine Debris Initiative (AMDI), in which we perform systematic data filtering, test for differences between collecting groups, and report patterns in marine debris. We defined five stages of data filtering to address issues in data quality and to limit inference to ocean-facing sandy beaches. Significant differences were observed in the average accumulation of items between filtered and remaining data. Further, differences in sampling were compared between collecting groups at the same site (e.g., government, NGOs, and schools), where no significant differences were observed. The filtering process removed 21% of events due to data quality issues and a further 42% of events to restrict analyses to ocean-facing sandy beaches. The remaining 7275 events across 852 sites allowed for an assessment of debris patterns at an unprecedented spatial and temporal resolution. Hard plastics were the most common material found on beaches both nationally and regionally, consisting of up to 75% of total debris. Nationally, land and sea-sourced items accounted for 48% and 7% of debris, respectively, with most debris found on the east coast of Australia. This study demonstrates the value of citizen science datasets with broad spatial and temporal coverage, and the importance of data filtering to improve data quality. The citizen science presented provides an understanding of debris patterns on Australia's ocean beaches and can serve as a foundation for future source reduction plans.

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More for less: Citizen science supporting the management of small-scale recreational fisheries

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While many global fisheries rely on commercial catch and effort statistics to inform stock assessments and management, alternative approaches are required for small-scale recreational fisheries. In this study, a citizen science program was implemented to collect recreational

catch and effort and fishery-independent data using three Western Australian blue swimmer crab (Portunus armatus) fisheries as case studies. Between 2013 and 2019, an opt-in Research Angler Program (RAP) was supported by 102 diarists submitting data from 1,705 fishing events, with direct and regular contact proving important for maintaining participation. Representing the only current recreational crabbing information for the three fisheries, the RAP data proved valuable in assessing management options (e.g. increases in size limits, bag limit reductions, seasonal closures) during a recent review of the Western Australian P. armatus resource. Two follow-up surveys to canvass diarist attitudes towards the program identified a desire to contribute to research and management, and concerns about fish stocks, as key motivations for involvement. In addition, 26 diarists assisted with fishery-independent breeding stock surveys (FIS) to collect valuable stock assessment data. The RAP and FIS proved complementary, as the first provided useful spatial/temporal coverage of catch rates and catch composition, while the second gave a targeted assessment of breeding stock abundance. We demonstrate how the data can generate annual fishery performance indices, such as standardised recreational catch rates and a fishery-independent egg production index, to support a potential harvest strategy. This study highlights a cost-effective and highly valuable citizen science approach to obtain key information for the assessment and management of small scale recreational fisheries, with suggested recommendations for researchers considering a similar approach elsewhere.

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Community-based citizen science projects can support the distributional monitoring of fishes

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1. Effective conservation and fisheries management requires data to capture demographic processes and range limits for each species to maximize population health and productivity. This need is constrained by limited funding and resources, particularly for countries with large land areas and coastlines as well as expansive exclusive economic zones. This imbalance means that monitoring efforts are often focused on targets of commercial and recreational fishing, which results in incomplete distributional records for non-target, small-bodied, and/or cryptic species.

2. Community-based citizen science projects offer one potential alternative for scientists and fisheries managers needing this type of information but lacking sufficient resources to gather it.
3. This study investigated whether data sourced from an online citizen science project (iNaturalist: Australasian Fishes) can assist in the distributional monitoring of a subset of fish species. Given the regional focus of this citizen science project, distributional data in the form of occurrence records for abundant, protected, and threatened fish species as assessed by the International Union for Conservation of Nature in Australia and New Zealand were explored. Data for important commercial and recreational fishery targets in New South Wales were also explored, as a case study of a large jurisdiction with extensive monitoring requirements.
4. The occurrence records for some of these categories of fishes were well represented in the quality-filtered citizen science data set, particularly endemic fishes whose threat status had not yet been assessed and species not currently under any form of management. Despite gaps in coverage between major urban centres, citizen science data for the best represented endemic fishes were qualitatively comparable to the available geographic distributions for these species.
5. We suggest that quality-filtered citizen science data can in fact be used to improve taxonomic representation and the geographic breadth of species monitoring with increased participation.

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Butterflies Australia: a national citizen science database for monitoring changesin the distribution and abundance of Australian butterflies

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Conservation biology is a field of science that is heavily biased against insects and allied invertebrates, largely due to a data deficiency feedback loop that maintains a cycle of ignorance and inaction. Because many invertebrate groups are, and remain, extremely data poor, it is frequently difficult to conduct even the most basic conservation actions, such as status evaluation, listing, recovery and monitoring of threatened species. Thus, declines and extinctions of invertebrates are frequently undetected and poorly documented. To address this data deficiency, we have developed a new national database – Butterflies Australia – for one insect taxon that integrates citizen science (data collectors) with global, standardised monitoring protocols and emerging tools in technology and biodiversity informatics. The database is created from a platform, which consists of a phone app and website, that offers

the potential to rapidly increase data availability on the occurrence of Australian butterflies at a far greater scale than was previously possible, as well as to monitor trends in their distribution and abundance over time. We discuss the attributes and importance of successful citizen science projects and quantitative methods for monitoring butterflies, both from an Australian perspective and in an international context, and then outline the operational aspects of the Butterflies Australia platform.
A review of survey methods that have been used for monitoring or inventorying butterflies in Australia over the past 50 years revealed a diverse array of sampling techniques, with little standardisation between studies and wide variation in space (sampling unit) and time (sampling effort). Transect counts, in particular, have rarely followed the international guidelines recommended for standardised global butterfly monitoring. Finally, we discuss the benefits of our new citizen science tool for butterflies and potentially other invertebrates. We envisage that our platform will engender increased community awareness, improved quantity and quality of data collection, better conservation policy and planning, as well as enhanced resourcing and research for the conservation management of butterflies.

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doi: https://10.1111/aen.12513 or
https://www.researchgate.net/profile/Michael-Braby/publication/348534830_Butterflies_Australia_a_national_citizen_science_database_for_monitoring_changes_in_the_distribution_and_abundance_of_Australian_butterflies/links/60e5155d299bf1b0319bcc00/Butterflies-Australia-a-national-citizen-science-database-for-monitoring-changes-in-the-distribution-and-abundance-of-Australian-butterflies.pdf

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Citizen-Driven Food System Approaches in Cities

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Driven by increased greenhouse gas emissions, climate change causes planetary disruptions such as rising temperatures and sea levels. Our food system contributes to this disruption as it is responsible for significant greenhouse gas emissions. Consequently, an urgent reorientation of the current food system and production methods towards a more plant-based diet is required to help stabilize climate change and improve human health. Driven by a neoliberal agenda with profit foremost, the food system cannot transform itself alone. No single measure will be enough to temper the environmental impact of food production. Strategic leadership and good governance involving food system actors and stakeholders working together are needed, but what role exists for individual city dwellers? The chapter begins by describing the impact of global food production and ultra-processed foods on sustainability and the importance of eating a plant-based diet. We introduce approaches to food system transformation and the importance of citizen science as a catalyst for change. We summarize why cities are an epicenter for food system transformation and the importance of involving

citizens in government-led urban action. We then introduce the concept of 'Citizenshift' to understand the shift from the dominant individualistic role of consumer to that of the citizen in fostering societal change. Using the frame of Citizenshift, we explore four examples of food-related approaches and engagement in cities to promote the sustainability of the food system. The chapter concludes with a discussion of the opportunities and challenges inherent in empowering people to participate in food system transformation.

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Citizen science in cities: an overview of projects focused on urban Australia

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Citizen science offers a unique opportunity to connect urban-dwellers with the often hidden natural world upon their doorsteps and to contribute to authentic research that increases knowledge of urban ecology and biodiversity. With the majority of Australia's population residing in large cities, this diverse potential pool of participants in science creates a significant opportunity to increase the spatial and temporal scale of research. Herein, we provide an overview of Australian urban citizen science projects based on an analysis of the projects listed in the Australian Citizen Science Association's Citizen Science Project Finder. We draw out key features (such as those with research questions specific to cities such as reintroduction and persistence of species in urban environments) from urban citizen science projects that make them suitable for the urban environment and use these features to suggest recommendations for further expansion and development of this important subset of projects. We conclude that the number and diversity of urban citizen science projects is relatively low in Australia, and advocate for an increase in initiatives that can tap into a large pool of potential participants for the benefit of science and society.

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Expanding the Scope of Citizen Science: Learning and Engagement of Undergraduate Students in a Citizen Science Chemistry Lab

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The COVID-19 pandemic has placed public health and wellbeing at the forefront of public concerns and interests, transforming the ways people interact and engage with science. One way to support and expand such engagement is through citizen science, which has seen huge growth over the past decade. Since many scientific fields are still largely underrepresented within citizen science, this paper explores the expansion of citizen science into new fields and settings. The study examines the learning processes and outcomes of students participating in a lab-based chemistry citizen science initiative, Breaking Good, and explores the "why," "how," and "what" of laboratory learning.

Our findings reveal a dynamic learning environment characterised by the hands-on, authentic, and novel science experience within these labs. The broader context afforded by a citizen science approach was found to enhance student knowledge of course content and knowledge of both the process and nature of science alongside increased motivation. As universities are ideally placed to incorporate citizen science into higher education teaching, this paper calls for research institutions to take a leading role in this process, promoting student learning and the development of scientific fields by expanding the scope of citizen science.

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Maggot Menageries: High School Student Contributions to Medicinal Maggot Production in Compromised Healthcare Settings

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This case study describes how high school students can participate in research, development, and testing of real-life solutions for society's most intractable problems. In modern warfare, civilians make up most of the casualties, and conflict-affected communities are often isolated and have only limited access to healthcare. Most surviving casualties have limb wounds from injury or surgery, and many of these become infected and require long-term treatment or amputation. In 2020, MedMagLabs and the Queensland Virtual STEM Academy partnered to engage high school students to co-develop and test methods and training resources that empower people in conflict-affected communities to produce medicinal maggots for highly efficacious and affordable wound care. Maggot therapy is the treatment of wounds with

living fly larvae to remove dead tissue, to control infection, and to promote wound healing. As opposed to most citizen science, which mainly focuses on data collection and/or educational and awareness-raising outcomes, this project focused on the co-creation of knowledge and the delivery of tangible research outcomes. The measure of its success was the development of end-user friendly medicinal maggot production methods and training resources. The study explains how citizen scientists and researchers collaborated with one another to achieve this objective. Project execution was largely in line with The Ten Principles of Citizen Science. Further review of project outcomes and self-reflection by the research team highlight important lessons for such collaborative studies, which have been summarised in five recommendations specifically relating to research collaborations with schools and student citizen scientists.

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Nature-Based Citizen Science as a Mechanism to Improve Human Health in Urban Areas

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The world is becoming increasingly urbanised, impacting human interactions with natural environments (NEs). NEs take a number of forms, ranging from pristine, modified, to built NEs, which are common in many urban areas. NEs may include nature-based solutions, such as introducing nature elements and biological processes into cities that are used to solve problems created by urbanisation. Whilst urbanisation has negative impacts on human health, impacting mental and physical wellbeing through a number of mechanisms, exposure to NEs may improve human health and wellbeing. Here, we review the mechanisms by which health can be improved by exposure to NEs, as explained by Stress Reduction Theory, Attention Restoration Theory, and the 'Old Friends'/biodiversity hypothesis. Such exposures may have physiological and immunological benefits, mediated through endocrine pathways and altered microbiota. Citizen Science, which often causes exposure to NEs and social activity, is being increasingly used to not only collect scientific data but also to engage individuals and communities. Despite being a named component of scientific and environmental strategies of governments, to our knowledge, the intrinsic health benefits of Citizen Science in NEs do not form part of public health policy. We contend that Citizen Science programs that facilitate exposure to NEs in urban areas may represent an important public health policy advance.

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