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.

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Andrew Kinsela

Abstracts of recently published journal articles

Exploring the ability of urban householders to correctly identify nocturnal mammals

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Urban landscapes present substantial opportunities for biodiversity conservation with residential gardens offering some of the greatest potential conservation gains given that they represent a significant proportion of the total greenspace in urbanised landscapes. However, knowledge of wildlife ecology within gardens remains scarce, likely due to the difficulties associated with field ecologists accessing privately owned areas. Citizen-sourced data presents an alternative approach to typical field-based investigations and could be used to develop an extensive understanding of biodiversity within privately owned green spaces, providing concerns of data unreliability could be overcome. Here we i) examine the potential for urban householders to identify a threatened nocturnal mammal, in the presence of a similar non-threatened species, ii) examine which attributes can predict the level of accuracy in householders' species identifications and iii) investigate how their self-reported level of certainty affects identification reliability. We found up to 80% agreement between householders and experienced ecologists when we assessed presence and absence of nocturnal mammals on urban properties. The amount of time a householder had lived at their residence was a significant predictor of accuracy for mammal species identification, suggesting that familiarity with a site enhances the accuracy of citizen science data. Those people with a high level of certainty in their ability to correctly identify nocturnal mammals were no more likely to show higher species identification accuracy than those with low certainty. In urban areas, where ecological surveys for nocturnal taxa are especially challenging, our results inspire optimism that householders can add to the body of knowledge about biodiversity persisting in these landscapes, especially on properties where they have resided for at least one year.

The promise of a "people-centred" approach to floods: Types of participation in the global literature of citizen science and community-based flood risk reduction in the context of the Sendai Framework

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Floods are expected to become more intense and increasingly frequent over the coming years. Over the last few decades, scholars, policy makers and risk managers have been gradually acknowledging that community-based initiatives can represent a promising alternative for addressing the hazard of floods at the local scale. In the context of the Sendai Framework for Disaster Risk Reduction 2015-2030 (SFDRR), this article presents a systematic literature review of the recent global body of literature on the topic. This work analyses 40 articles published over the last five years to identify the types of engagement allowed in the projects and to discuss the emerging debates in the field since the establishment of the SFDRR. The literature review interrogates where these approaches are being developed and how community-based approaches have been supporting the achievement of the SFDRR targets. The review shows that a growing body of literature has been applying community-based

disaster risk reduction (CBDRR) and citizen science methods in order to respond to the call for a more people-centred approach towards floods. This call, outlined by the SFDRR, is particularly relevant in the context of vulnerable communities such as the residents of informal settlements, which have historically been disproportionately affected by floods. The article then provides an original contribution to the field by documenting and reflecting on the firsthand findings of a long-term community-based program assessing flood risks conducted within the Revitalising Informal settlements and Their Environments (RISE) program. The article outlines the implementation, operation and initial findings of the project, which involved community-members in the documentation of flood-levels in informal settlements in Suva, Fiji and Makassar, Indonesia between 2018 and 2020. The findings from the case study suggest that approaches involving communities in flood monitoring can, beyond facilitating flood documentation, unlock additional risk reduction benefits such as enhancing social capital and facilitating risk communication. The conclusions highlight that, similar to RISE's flood monitoring project, several other community-based initiatives have been developed all over the world. While these initiatives vary significantly in the degrees of community participation and their methods, most of the literature agrees that these emerging methods are considered particularly promising in terms of improving disaster knowledge and awareness when community members participate in disaster risk reduction. The review of this body of literature, however, indicates that more research is needed to examine how social capital as well as cultural and political aspects can be harnessed and strengthened to play important roles in the response to floods.

Species on the move around the Australian coastline: A continental-scale review of climate-driven species redistribution in marine systems

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Climate-driven changes in the distribution of species are a pervasive and accelerating impact of climate change, and despite increasing research effort in this rapidly emerging field, much remains unknown or poorly understood. We lack a holistic understanding of patterns and processes at local, regional and global scales, with detailed explorations of range shifts in the southern hemisphere particularly under-represented. Australian waters encompass the world's third largest marine jurisdiction, extending from tropical to sub-Antarctic climate zones, and have waters warming at rates twice the global average in the north and two to four times in the south. Here, we report the results of a multi-taxon continent-wide review describing observed and predicted species redistribution around the Australian coastline, and highlight critical gaps in knowledge impeding our understanding of, and response to, these considerable changes.

Since range shifts were first reported in the region in 2003, 198 species from nine Phyla have been documented shifting their distribution, 87.3% of which are shifting poleward. However, there is little standardization of methods or metrics reported in observed or predicted shifts, and both are hindered by a lack of baseline data. Our results demonstrate the importance of historical data sets and underwater visual surveys, and also highlight that approximately one-fifth of studies incorporated citizen science. These findings emphasize the important role the public has had, and can continue to play, in understanding the impact of climate change. Most documented shifts are of coastal fish species in sub-tropical and temperate systems, while tropical systems in general were poorly explored. Moreover, most distributional changes are only described at the poleward boundary, with few studies considering changes at the warmer, equatorward range limit. Through identifying knowledge gaps and research limitations, this review highlights future opportunities for strategic research effort to improve the representation of Australian marine species and systems in climate-impact research.

Using citizen science in the photo-identification of adult individuals of an amphibian based on two facial skin features

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Among amphibians, adults have traditionally been identified in capture-mark-recapture studies using invasive marking techniques with associated ethical, cost and logistical considerations. However, species in this group may be strong candidates for photo-identification based on natural skin features that removes many of these concerns, with this technique opening up opportunities for citizen scientists to be involved in animal monitoring programs. We investigated the feasibility of using citizen science to distinguish between individuals of an Australian anuran (the sandpaper frog, *Lechriodus fletcheri*) based on a visual analysis of their natural skin features. We collected photographs of marked individuals in the field over three breeding seasons using a smartphone device. This photo-database was used to create an online survey to determine how easily members of the general public could photo-match individuals by a comparison of two facial skin features; black banding that runs horizontally above the tympanum and a background array of tubercles present in this region. Survey participants were provided with 30 closed, multiple choice questions in which they were asked to match separate images of a query frog from small image pools of potential candidate matches. Participants were consistently able to match individuals with a low matching error rate (mean ± SD of 26 ± 5) despite the relatively low quality of photographs taken from a smartphone device in the field, with most query frogs being matched by a majority of participants (mean ± SD of 86.02 ± 9.52%). These features were found to be unique and stable among adult males and females. Thus, photo-identification is likely to be a valid, non-invasive method for capture-mark-recapture for *L. fletcheri*, and likely many anurans that display similar facial skin features. This

may become an important alternative to artificial marking techniques, with the challenges of manual photo-matching reduced by spreading workloads among members of the public that can be recruited online.

Raising awareness of ciguatera fish poisoning in Australia: a survey of recreational fishers

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Ciguatera fish poisoning is the most frequent seafood related illness in Australia, despite only an estimated 20% of cases being reported to authorities. To raise awareness of ciguatera, SafeFish initiated an awareness campaign that included an online survey of recreational fishermen. The survey aimed to determine current awareness levels, how best to raise these levels and to briefly gauge how much support there was in the recreational fishing community for citizen science projects. Promoted through Facebook, the survey was shared 35 times, received a total of 223 likes and attracted over 90 user comments. Answered by 236 individuals, the survey revealed that individuals were largely aware of ciguatera (90%) and 29 individuals identified as having suffered from ciguatera before (only 59% had their diagnosis confirmed by a health care worker).

Recreational fishers indicated that the currently available information on ciguatera did not meet their needs, particularly in regard to the desired level of detail. The specific areas that respondents were most interested in knowing more about included a list of at-risk fish species; information on poisoning symptoms and treatment options; as well as toxin uptake pathways. As the majority of fishers indicated, this information would be best presented in the form of fact sheets/pamphlets, videos or written articles, while infographics and social media posts were determined to be of mild interest. The preferred way of accessing this type of information was online. Another avenue of engaging with recreational fishers is through citizen science projects, towards which most of the surveyed fishers responded positively. The SafeFish ciguatera awareness campaign will now focus on developing the requested information materials and disseminating them online through the SafeFish website and the Northern Territory Fisheries Department, as well as the social media and recreational fishing networks originally used to recruit survey participants.

Quantification and exposure assessment of microplastics in Australian indoor house dust

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Limited attention has been given to the presence of MPs in the atmospheric environment, particularly in indoor environments where people spend about 90% of their time. This study quantitatively assesses the prevalence, source and type of MPs in Australian homes with the goal of evaluating human health exposure potential. Thirty-two airborne indoor deposited dust samples were collected in glass Petri dishes from Sydney (Australia) homes, over a one-month period in 2019. Participants completed a questionnaire on their household characteristics. Samples were analysed using a stereomicroscope, a fluorescent microscope and micro-Fourier transform infrared (FTIR) spectroscopy for their colour, size, shape and composition. Inhalation and ingestion rates were modelled using US EPA exposure factors. Microplastic fibre deposition rates ranged from 22 to 6169 fibres/m2/day. Deposited dust comprised 99% fibres. The highest proportion of fibres (19%) were 200–400 μm in length. The majority were natural (42%); 18% were transformed natural-based fibres; and 39% were petrochemical based. A significant difference was observed between the deposition rate and the main floor covering (p-value <0.05). Polyethylene, polyester, polyamide, polyacrylic, and polystyrene fibres were found in higher abundance in homes with carpet as the main floor covering. Where carpet was absent, polyvinyl fibres were the most dominant petrochemical fibre type, indicating the role of flooring materials (e.g. wood varnishes) in determining MP composition. Vacuum cleaner use was significantly related to MP deposition rates (p-value <0.05). MP ingestion rates peaked at 6.1 mg/kg-Bw/year for ages 1–6, falling to a minimum of 0.5 mg/kg-Bw/year in >20 years age group. Mean inhaled MP weight and count was determined to be 0.2±0.07 mg/kg-Bw/year and 12891±4472 fibres/year. Greatest inhalation intake rates were for the <0.5-yr age group, at 0.31 mg/kg-Bw/year. The study data reveal that MPs are prevalent in Australian homes and that the greatest risk of exposure resides with young children. Notwithstanding the limited number of global studies and the different methods used to measure MPs, this study indicates Australian deposition and inhalation rates are at the lower end of the exposure spectrum.

Ecosystem type drives tea litter decomposition and associated prokaryotic microbiome communities in freshwater and coastal wetlands at a continental scale

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Wetland ecosystems are critical to the regulation of the global carbon cycle, and there is a high demand for data to improve carbon sequestration and emission models and predictions. Decomposition of plant litter is an important component of ecosystem carbon cycling, yet a lack of knowledge on decay rates in wetlands is an impediment to predicting carbon preservation. Here, we aim to fill this knowledge gap by quantifying the decomposition of standardised green and rooibos tea litter over one year within freshwater and coastal wetland soils across four climates in Australia. We also captured changes in the prokaryotic members of the tea-associated microbiome during this process. Ecosystem type drove differences in tea decay rates and prokaryotic microbiome community composition. Decomposition rates were up to 2-fold higher in mangrove and seagrass soils compared to freshwater wetlands and tidal marshes, in part due to greater leaching-related mass loss. For tidal marshes and freshwater wetlands, the warmer climates had 7–16% less mass remaining compared to temperate climates after a year of decomposition. The prokaryotic microbiome community composition was significantly different between substrate types and sampling times within and across ecosystem types. Microbial indicator analyses suggested putative metabolic pathways common across ecosystems were used to breakdown the tea litter, including increased presence of putative methylotrophs and sulphur oxidisers linked to the introduction of oxygen by root in-growth over the incubation period. Structural equation modelling analyses further highlighted the importance of incubation time on tea decomposition and prokaryotic microbiome community succession, particularly for rooibos tea that experienced a greater proportion of mass loss between three and twelve months compared to green tea. These results provide insights into ecosystem-level attributes that affect both the abiotic and biotic controls of belowground wetland carbon turnover at a continental scale, while also highlighting new decay dynamics for tea litter decomposing under longer incubations.

Combining cameras and citizen science to define the distribution and behaviour of dingoes and foxes in New South Wales

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We used two survey methods - citizen science for private land and cameras for protected areas - to map the distribution of dingoes/wild dogs and foxes in NSW. Dingo/wild dog records were mostly confined to the east coast and ranges, with scattered locations in western NSW. This contrasts to the distribution of foxes, in which occupancy was high across most of the state. Data from 200 WildCount camera sites within protected areas also showed marked differences in the distribution of the two canid species. At the scale of the state, dingoes/wild dogs are uncommon, with the greatest concentration being in the north-east of the state, as well as a marked presence in the south-east. Foxes are common and widespread within protected areas, but less common in the north-east of the state. The camera data also indicated that feral cats are widespread within protected areas. The second aim of our study was to examine the WildCount data for behavioural patterns of the canid species. Foxes and dingoes/wild dogs significantly separated within two sub-formations of dry sclerophyll forest based on the Keith (2004) classification of NSW vegetation. From species pairwise interactions at sites, we found only limited evidence for significant interactions, and then only for the co-occurrence of fox-rabbit and fox-swamp wallaby, but no avoidance for any of the predators with each other. Camera records of the time of day of being active showed little effect of the presence of dingoes/wild dogs on the times of activity of foxes, but foxes curtailed the activity times of dingoes/wild dogs. From the analysis of inter-animal times at sites where both canids were recorded, there was little difference between the time since the other species was present. Thus, there was no evidence that dingoes/wild dogs or foxes inhibit the other from being at a site. We concluded that at the landscape level, both vegetation type and land tenure play a role in the interactions between dingoes/wild dogs and foxes. We also concluded that citizen science and cameras are complementary, not alternative techniques, especially as they sample different land tenures, and that cameras in protected areas and occupancy from citizen science have produced higher resolution maps and behaviour patterns than have been previously available. We can confirm that foxes are a ubiquitous threat throughout NSW, whereas dingoes/wild dogs are concentrated into a much smaller area of eastern, particularly north-eastern, NSW.

A citizen science approach to identifying trace metal contamination risks in urban gardens

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We launched the VegeSafe program in 2013 to assist Australians concerned about exposure to contaminants in their soils and gardens. VegeSafe analyses garden soils provided by citizens for trace metals at our laboratory at little to no cost, with easy-to-follow guidance on any intervention required. The response was overwhelming—Australians submitted 17,256 soils from 3,609 homes, and in turn VegeSafe researchers now have unparalleled household-scale data, providing new insights into urban trace metal contamination. The results are sobering, with 35% of homes, particularly those that are older, painted and located in inner cities having soils above the Australian residential guideline (300 mg/kg) for the neurotoxic trace metal lead (Pb). Exposure pathway, blood Pb concentration and vegetable uptake modelling showed the communities in these locations were most at risk. VegeSafe is transformative: 94% of participants better understood contaminants, 83% felt safer in their home environment and 40% undertook remedial action based on their results. The two-way nature of this program enables education of citizens about environmental contaminants, advances public health, and delivers impactful science.

If I fits I sits: A citizen science investigation into illusory contour susceptibility in domestic cats (Felis silvestris catus)

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A well-known phenomenon to cat owners is the tendency of their cats to sit in enclosed spaces such as boxes, laundry baskets, and even shape outlines taped on the floor. This investigative study asks whether domestic cats (Felis silvestris catus) are also susceptible to sitting in enclosures that are illusory in nature, utilizing cats' attraction to box-like spaces to assess their perception of the Kanizsa square visual illusion. Carried out during the COVID-19 pandemic, this study randomly assigned citizen science participants Booklets of six randomized, counterbalanced daily stimuli to print out, prepare, and place on the floor in pairs. Owners

observed and videorecorded their cats' behavior with the stimuli and reported findings from home over the course of the six daily trials. This study ultimately reached over 500 pet cats and cat owners, and of those, 30 completed all of the study's trials. Of these, nine cat subjects selected at least one stimulus by sitting within the contours (illusory or otherwise) with all limbs for at least three seconds. This study revealed that cats selected the Kanizsa illusion just as often as the square and more often than the control, indicating that domestic cats may treat the subjective Kanizsa contours as they do real contours. Given the drawbacks of citizen science projects such as participant attrition, future research would benefit from replicating this study in controlled settings. To the best of our knowledge, this investigation is the first of its kind in three regards: a citizen science study of cat cognition; a formal examination into cats' attraction to 2D rather than 3D enclosures; and study into cats' susceptibility to illusory contours in an ecologically relevant paradigm. This study demonstrates the potential of more ecologically valid study of pet cats, and more broadly provides an interesting new perspective into cat visual perception research.

Engaging with Nature Sounds & Citizen Science by Designing for Creative & Contextual Audio Encounters

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Wildlife calls are the best witnesses to the health of ecosystems, if only we know how to listen to them. Efforts to understand and inform restoration of healthy ecosystems with environmental audio recordings languish from insufficient tools to learn and identify sounds in recordings. To address this problem, we designed and playtested the Bristle Whistle Challenge prototype with ten players. We explored how to design delightful interactions with audio for gaining awareness of nature sounds and supporting wildlife conservation through citizen science. We found that rather than presenting audio alone, it was necessary to connect sounds to other senses and experiences in creative ways to impart meaning and enhance engagement. We offer recommendations to design creative and contextual interactions with media to build awareness of nature's wonders. We call for greater efforts in interaction design to engage people with nature, which is the key to turning around our environmental crisis.

EchidnaCSI – Improving monitoring of a cryptic species at continental scale using Citizen Science

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Short-beaked echidna (Tachyglossus aculeatus) are a cryptic and iconic monotreme found throughout the continent of Australia. Despite observational records spanning many years aggregated in national and state biodiversity databases, the spatial and temporal intensity of sightings is limited. Although the species is of least conservation concern at the global level, a subspecies has been declared endangered on Kangaroo Island in South Australia. We need better population data over the whole continent to inform this species' conservation management. To increase the temporal and spatial resolution of observations which may be used for more accurate population assessments, we developed a mobile app for citizen scientists to easily record echidna sightings and improve the quantity, quality and distribution of data collected for monitoring this species. EchidnaCSI is a free, cross-platform (Android & iOS), open-source app that we developed to collect echidna observational data around Australia. EchidnaCSI has been in use since September 2017 and uses mobile phone sensors to transparently and automatically record metadata, such as species observation location and time and GPS location precision. We examine differences in spatial coverage between these observations and those in existing data repositories in the Atlas of Living Australia and state biodiversity databases, especially in relation to observations in protected areas and to an index of remoteness and accessibility. EchidnaCSI has contributed over 8000 echidna observations from around Australia, more than recorded in all state systems combined, with similar spatial distribution. Although coverage was more limited in some protected areas than the reference data sources, numbers of observations in all remote areas were greater than the reference scientific data except for very remote regions. EchidnaCSI has improved the spatial and temporal intensity of observations for this iconic species and provides a complement to scientific surveys, which might usefully focus on highly protected areas and very remote regions.

Species' traits drive amphibian tolerance to anthropogenic habitat modification

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Anthropogenic habitat modification is accelerating, threatening the world's biodiversity. Understanding species' responses to anthropogenic modification is vital for halting species'

declines. However, this information is lacking for globally threatened amphibians, informed primarily by small community-level studies. We integrated >126,000 verified citizen science observations of frogs, with a global continuous measure of anthropogenic habitat modification for a continental scale analysis of the effects of habitat modification on frogs. We derived a modification tolerance index—accounting for anthropogenic stressors such as human habitation, agriculture, transport and energy production—for 87 species (36% of all Australian frog species). We used this index to quantify and rank each species' tolerance of anthropogenic habitat modification, then compiled traits of all the frog species and assessed how well these equipped species to tolerate modified habitats. Most of Australia's frog species examined were adversely affected by habitat modification. Habitat specialists and species with large geographic range sizes were the least tolerant of habitat modification. Call dominant frequency, body size, clutch type and calling position (i.e. from vegetation) were also related to tolerance of habitat modification. There is an urgent need for improved consideration of anthropogenic impacts and improved conservation measures to ensure the long-term persistence of frog populations, particularly focused on specialists and species identified as intolerant of modified habitats.

Ecological insights into a charismatic bird using different citizen science approaches

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Citizen science projects provide valuable ecological data owing to their capacity to collect a wide variety of data at scales that would be difficult to achieve through traditional methods. A trade-off exists between the complexity of data collected and participation, with projects typically falling into a continuum between documenting the presence of species at a location, through to the collection of detailed ecological data using complex protocols. Researchers must balance an approach that suits their aims with maximising participation. However, the ability of different citizen science approaches to collected detailed ecological data for a target species is poorly understood. We compared the number of participants and amount of data collected from the three projects to explore different citizen science approaches for focal species research. We examine data for the Australian brush-turkey (Alectura lathami) from two open survey citizen science projects and one focal species project: iNaturalist, eBird and BrushTurkeys. Over a period of 18 months, eBird recorded the greatest number of participants (n = 1861) and presence records of brush-turkeys (n = 17810). Across the three projects participation varied significantly with an average of 1.95 (range = 1–65), 9.6 (range = 1–389) and 4.7 (range = 1–331) reports per citizen scientist, respectively. The targeted BrushTurkeys project collected specific ecological data including counts, sex and behaviours in a higher proportion of sightings and recorded the largest number of nest mound reports compared with

eBird and iNaturalist. We confirm that engaging an active group of participants produced the largest amount of data (eBird), including reports per participant. Ecologically, the most detailed information on habitat use and behaviours came from the focal citizen science project (BrushTurkeys). We conclude that seeking opportunities to grow and actively engage existing citizen science communities to report more detailed ecological information is likely to produce more detailed and informative data set.

Malleefowl Leipoa ocellata breeding behaviour: Insights from citizen science camera surveillance

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Observations on natural history are a useful but often overlooked branch of ecology. With the use of camera-traps, collection of data e.g. on breeding behaviour and success has never been easier, particularly when studying cryptic species. Additionally, camera-traps are well suited to citizen science because of their ease of operation and the ability to store and verify data. Malleefowl Leipoa ocellata breeding behaviour has previously been studied through direct observation or timelapse photography, resulting in small sample sizes and potentially biased observations. Using camera-trap data collected by citizen scientists, we examined the breeding behaviour of this species. We quantified the timing and duration of mound-tending activities at 20 mounds using camera surveillance for >30,000 hours (1250 days) over six breeding seasons. Time spent at the mound during five mound stages and visit frequencies by the male and female during each stage are reported. Female involvement at the mound was consistent, although males spent three times as long at the mound compared with females during egg-laying. On egg-laying days, females spent longer uncovering the mound, compared with covering the mound post egg-laying. Our findings confirm that both male and female Malleefowl spend a substantial amount of time constructing and maintaining their mound throughout the year and, most notably, that the female consistently participates in mound-tending. These insights are particularly valuable as our surveillance was over markedly longer time spans than previous studies that relied upon direct observation.

Malleefowl Leipoa ocellata incubation mounds as habitat for other vertebrates

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Ecosystem engineers change the availability of resources for other species by forming new habitat or modifying existing habitat but, despite the diversity of avian ecosystem engineers, 80% of current literature focuses on mammals and invertebrates. Malleefowl Leipoa ocellata build large incubation mounds of soil and leaf-litter that are likely to provide habitat for invertebrates and vertebrates but use of their mounds by other vertebrates has never been quantified. Here, we examine vertebrate fauna visitation rates at Malleefowl mounds and non-mounds using camera-trap data collected by two citizen science projects. From 2012 to 2018, 20 active Malleefowl mounds and 16 non-mound sites were monitored over 31,913 hours and 225,144 hours, respectively. In total, we identified visits by 1724 birds, reptiles and mammals from 36 species. The mean number of vertebrate visits per 1000 hours of surveillance was around one and a half times and species richness five times that at mounds compared with non-mounds. Malleefowl mounds may enhance the availability of invertebrate prey for insectivorous birds and mammals, provide a favourable microclimate for reptiles to thermoregulate, and be signalling/social communication locations. Our results show that further research is warranted and suggest that conservation of Malleefowl may be important not only for the Malleefowl itself, but also for a suite of mallee birds and reptiles.

Predicting koala (Phascolarctos cinereus) distribution from incidental sighting data in South-East Queensland, Australia

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Species distribution maps are important tools for wildlife conservation planning and management. To model koala distributions, usually, a spatially representative sample of koala populations is collected through systematic field surveys. Details of koala sightings collected by members of the public could potentially be used to develop species distribution models if appropriate analytical approaches are applied to address the inherent biases in such datasets. We developed a stepwise approach for applying bias correction techniques to estimate and map koala distributions. Using a Boosted regression tree approach, we modelled indirectly the search effort made by observers to identify or sight koalas. Land lot density (58%) and human population density (19%) had the strongest positive impact on the indirect search effort, while

the distances to roads were negatively associated with the indirect search effort. To estimate the koala distribution across South-East Queensland, we then developed models describing koala habitat (environmental model), access to koala habitat (accessibility model) and the search effort (search effort model), with the latter including the indirect search effort covariate. Finally, we corrected the estimates derived from these models (bias-corrected search effort and accessibility model). Three independent statistical modelling approaches (Lasso penalty Poisson regression, Down-weighted Poisson regression, and Maximum entropy) were used to compare the five koala distribution models. Based on assessments of areas under curves, the predictive accuracy of models improved when area accessibility and search effort were included. Overall, the spatial extent of koala distributions increased in the prediction maps when models were corrected for accessibility and indirect search effort (except for Down-weighted Poisson regression).

First evidence of bubble-net feeding and the formation of 'super-groups' by the east Australian population of hump back whales during their southward migration

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The recovery of overexploited populations is likely to reveal behaviours that may have been present prior to harvest but are only now reappearing as the population size increases. The east Australian humpback whale (Megaptera novaeangliae) population (group V, stock E1) has recovered well from past exploitation and is now estimated to be close to the pre-whaling population size.

Humpback whales were thought to follow a 'feast and famine' model historically, feeding intensively in high-latitude feeding grounds and then fasting while migrating and in calving grounds; however, there is growing evidence that animals may feed outside of known foraging grounds.

This short article reports on the first photographically documented evidence of bubble-net feeding by humpback whales in Australian coastal waters (n = 10 groups observed) and provides the first evidence of a second site in the southern hemisphere for the formation of 'super-groups' (n = 6 super-groups at discrete locations).

The formation of super-groups may be linked to changes in the type or density of prey available, either along the migratory route or in the feeding grounds of the previous summer. It is also possible that the increased population size following recovery make large group sizes while feeding more common. These findings strongly support evidence that feeding behaviour is not restricted to high-latitude foraging grounds in the Southern Ocean, and that prey

consumption prior to leaving the coastal waters of Australia may be a significant component of the migratory ecology of this population.

Understanding how environmental variation influences the extent to which humpback whales depend on foraging opportunities along their migratory route, and where feeding occurs, will help to predict how future changes in the ocean will influence whale populations. This will also allow for more effective management measures to reduce the impact of threats during this important period of energy consumption.

A proposed framework for reporting mass mortality (wreck) events of seabirds

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There is an absence of quantitative criteria and definitions for unusual or anomalous mortality events involving birds, often referred to as "wrecks". These events most commonly involve seabirds, although terrestrial bird wrecks have also been documented. Typically, the peer-reviewed literature investigating wreck events lacks the details necessary to further our understanding of the circumstances and potential causes of these events. This study reviewed the peer-reviewed literature for wrecks involving Ardenna seabirds (shearwaters), and included grey literature and data collected by citizen science (community) groups. Our results showed a significant time-lag between wreck events and when the data was published in the peer-reviewed literature, which did not occur in the grey literature. Both the grey and peer-reviewed literature were often skewed towards reporting larger wreck events, with only the citizen science dataset capturing smaller wrecks. We outline a proposed framework for reporting mortality events, including the use of quantitative categories to document the numbers of birds involved and taxon-specific thresholds. In doing so, we aim to establish a framework to aid in the quantitative reporting and analyses of future seabird wrecks.

A transdisciplinary approach supports community-led water quality monitoring in river basins adjacent to the Great Barrier Reef, Australia

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Water quality monitoring programs (WQMPs) are crucial for assessment of water quality in river basins where agricultural intensification and development raise concerns in freshwater and marine environments. WQMPs if supported by scientists and local communities, and if based on the knowledge needs of all stakeholders, can provide vital information supporting resource management actions.

Our paper focuses on the transdisciplinary development and implementation of a community-led pilot WQMP for the Tully River basin, adjacent to the Great Barrier Reef (GBR). The community-led pilot WQMP was established to fill some knowledge gaps identified during development of the Tully Water Quality Improvement Plan (WQIP) and to provide opportunities for active stakeholder participation in the monitoring. Results indicated some water quality parameters (i.e. nitrates and total phosphorus) had higher than expected values and exceeded state water quality guidelines. Hence, the results provided an evidence base for freshwater quality objective development to conserve, protect and improve water quality conditions in this basin and GBR. Leadership of Indigenous people in the pilot WQMP recognizes their deep desire to improve water resources outcomes and to care for country and people.

Not Well Enough to Attend Appointments: Telehealth Versus Health Marginalisation

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Temporary telehealth initiatives during COVID-19 have been life-changing for many people in Australia; for the first time Frail, Homebound, and Bedridden Persons (FHBP) equitably received primary healthcare services, like Australians without a disability. However, government changes to telehealth funding mean that since July 2020 telehealth is only available for those who have attended a face-to-face appointment in the last 12 months, thus excluding FHBP. This paper illustrates the reported health exclusion and marginalisation of FHBP. We reviewed the literature and surveyed 164 Australian adults (27% homebound people and 73% affiliated persons) to ascertain their opinions and thoughts on potential strategies to tackle issues associated with FHBP's current circumstances. Results demonstrate that digital technologies and telehealth services are ethical imperatives. Policymakers, clinicians, and health researchers must work with end-users (community-based participation) to create an inclusive healthcare service.

Understanding the Motivations and Satisfactions of Volunteers to Improve the Effectiveness of Citizen Science Programs

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Citizen science is a useful approach for conducting scientific research; however, an understanding of the motivations, satisfactions, and other aspects of volunteers' psychology is essential for conservation scientists wishing to mobilize this resource. We tested psychometric instruments for assessing the motivations, satisfactions, and advocacy role of volunteers with the Second Southern African Bird Atlas Project (SABAP2). Data were collected through stakeholder and volunteer surveys, and focus groups with the program's management. Qualitative and quantitative data analysis included content analysis, statistical tests of internal consistency, and factor analysis. An inventory, the Environmental Volunteer Functions Inventory (EVFI), was tested for assessing volunteer motivations along with scales for assessing volunteer satisfaction and level of advocacy. These scales revealed that volunteers in SABAP2 are satisfied with the program and exhibit behaviors suggesting they act as advocates for the program. Insights and a platform for adaptive management are provided for managers of the social dimensions of citizen science and other conservation programs.

Using citizen science to empower older adults to improve a food security initiative in Australia

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Food security is an increasing problem for older adults who are living longer and having to stretch their resources further. Initiatives such as subsidized community market days are increasingly important in bolstering food security amongst these groups but there have been few attempts to understand these initiatives from the perspective of community members. This exploratory study examined the utility of a novel citizen science approach to engage older adults in evaluating and improving a local food security initiative. Using the Our Voice methodology, citizen scientists recorded their perceptions of their local Market Day via photographs and audio narratives. Thirteen citizen scientists captured 127 photographs and 125 commentaries. Citizen scientists participated in workshops to discuss, code and synthesize their data, and used their findings to advocate for change. A number of improvements to the Market Day were made by key stakeholders on the basis of citizen scientist recommendations, including improving the processes for sourcing and storing food and changing the layout to improve access. This study demonstrates that citizen science is a useful and feasible approach to engaging community members in capturing data and advocating for change to ensure that local initiatives meet the needs of communities.