Guideline to develop future Great Barrier Reef Citizen Science Projects

Australian Citizen Science Association

2025

Acknowledgements:

The author would like to thank the members of the project's Critical Friends Group including Jennifer Loder (Great Barrier Reef Foundation), Jock MacKenzie (EarthWatch Australia), Steve Roeger (Roeger Consulting Services), Dr Adam Smith (Reef Ecologic), Prof. Stephen Turton (Australian Citizen Science Association), Dave Wildermuth (Department of Environment, Tourism, Science and Innovation) and Darryl Ebenezer (Queensland Water and Land Carers). The project team would also like to thank Queensland's Citizen Science project leaders that completed our survey or participated in the semi-structured interviews. Your knowledge and experience have been invaluable and where possible your input has been incorporated into the guidelines document or project reports and recommendations.

This guideline was developed with support from the Australian Government's Reef Trust program.

Australian Government

Department of Climate Change, Energy, the Environment and Water

Australian Citizen Science Association

Suggested citation:

Australian Citizen Science Association, 2025. Guideline to develop future Great Barrier Reef citizen science projects.

Contents

The Great Barrier Reef

Inscribed on the World Heritage list in 1981, the Great Barrier Reef (GBR) is the world's most extensive coral reef ecosystem, covering an area of 348,700 square kilometres and extending 2300 kilometres along the coast of Queensland across a contiguous latitudinal range of 14° (10°S to 24°S).

The GBR includes extensive cross-shelf diversity, stretching from the low water mark along the mainland coast up to 250 kilometres offshore. This wide depth range includes vast shallow inshore areas, mid-shelf and outer reefs, and beyond the continental shelf to oceanic waters over 2,000 metres deep.

Within the GBR there are over 2,900 individual reefs of varying sizes and shapes, and over 900 islands, ranging from small sandy cays and larger vegetated cays to large rugged continental islands rising, in one instance, over 1,100 metres above sea level. Collectively these landscapes and seascapes provide some of the most spectacular maritime scenery in the world.

The latitudinal and cross-shelf diversity, combined with diversity through the depths of the water column, encompasses a globally unique array of ecological communities, habitats and species. This diversity of species and habitats, and their interconnectivity, make the GBR one of the richest and most complex natural ecosystems on earth. There are over 1,500 species of fish, about 400 species of coral (in 60 genera), 4,000 species of mollusc, plus a great diversity of sponges, anemones, marine worms, crustaceans, and other species. It also contains a significant number of threatened species.

There are also large ecologically important inter-reef areas. The shallower marine areas support half the world's diversity of mangroves and many seagrass species. The waters also provide major feeding grounds for one of the world's largest populations of the threatened dugong. At least 30 species of whales and dolphins occur here, and it is a significant area for humpback whale calving.

Six of the world's seven species of marine turtle occur in the GBR. As well as the world's largest green turtle breeding site at Raine Island, the GBR also includes many regionally important marine turtle rookeries.

Some 242 species of birds have been recorded in the GBR. Twenty-two seabird species breed on cays and some continental islands, and some of these breeding sites are globally significant; other seabird species also utilize the area. The continental islands support thousands of plant species, while the coral cays also have their own distinct flora and fauna.

No other World Heritage property contains such biodiversity. This diversity, especially the endemic species, means the GBR is of enormous scientific and intrinsic importance to Australia and the global community.

The GBR World Heritage Area is threatened by global climate change and water quality issues, associated with land use activities in its catchments that drain into the GBR lagoon. The 2020 World Heritage Outlook Report describes its conservation outlook as "critical".

Finally, the GBR also has an economic, social and icon asset value of $56 billion. It supports 64,000 jobs and annually contributes $6.4 billion to the Australian economy, 33,000 jobs and 3.9 billion of this is within Queensland (Deloitte Access Economics, 2013).

Introduction

The Australian Citizen Science Association (ACSA) defines citizen science as: *public participation and collaboration in scientific research with the aim to increase scientific knowledge*. Citizen science is sometimes called community science, participatory research or participatory science.

If you are embarking on a citizen science journey, as a project leader, project supporter or volunteer, then you are joining a growing community of citizen scientists from around the world that are contributing information from their local environment that collectively increases knowledge of our natural world.

Although *citizen science* is a relatively new term, first appearing in literature around 1995, the collection of data or observations by community members that were then shared with scientists to increase knowledge, has been practiced in Australia for hundreds, if not thousands, of years.

Traditional owners were our first citizen scientists, observing species or system changes, sharing this Traditional Ecological Knowledge (TEK) orally and using this information to support sustainable management of Country.

But what is a comparatively new field, is the coordinated collection and analysis of data collected by citizen scientists, with some of the first Queensland examples being the Queensland Turtle Conservation Project (1975), Seagrass Watch (1998) and Reef Check (2001).

Citizen science is not highly regulated, nor is it driven by government policy, despite supporting documents such as the *Queensland Citizen Science Strategy* (Office of the Queensland Chief Scientist, 2018). Given this, projects display a range of program goals that include scientific, management, educational, social and economic outcomes developed from a range of models including:

- **Top-down** from government, e.g., Eye on the Reef (Great Barrier Reef Marine Park Authority) or the Keen Angler Program (Department of Primary Industries) to support management outcomes.
- **Bottom-up** (Grassroots), e.g., Leeper Reef - Diversity and Resilience Study (Mackay Regional Library and Sarina State High School) to increase local knowledge, education and awareness.
- **Research-driven**, e.g., Minke Whale Project (James Cook University), Project Manta (University of the Sunshine Coast), and RedMap (University of Tasmania) to increase knowledge.
- **Locality-based** - where external partners may host one or more projects in their local area, e.g., Mackay Turtle Watch which delivers the Queensland Turtle Conservation Project in the Mackay region, while Cairns and Far North Environment Centre (CAFNEC) host MangroveWatch and Saltmarsh monitoring.
- **First Nations-led** - some First Nations Peoples through their Indigenous Land and Sea Ranger teams in identifying their priorities for Country are choosing to support one or more citizen science projects that are relevant to their interests. These projects may be co-designed or adapted to meet specific community needs, custodial responsibilities or aspirations. There are very few citizen science projects that are currently First Nations designed or led, examples include the Yirrganydji Land and Sea Rangers' crocodile monitoring program. The number of First Nations-led projects is likely to increase as communities are empowered and supported

to monitor and manage Country, e.g., recording data to support seasonal calendars or to modify cultural burning with climate change.

- **Independent** - a small number of projects are focused on providing educational, voluntourism or eco-tourism opportunities. There are two types of groups that fall under this banner, those that use their own income to progress citizen science and those seeking to enhance visitor experience or derive an income from citizen science.

Less bound to a single institution than their research counterparts, citizen science projects may also move their operations. For example, Seagrass Watch was originally hosted by the Department of Primary Industries (Queensland Fisheries) before moving to TROPWater (James Cook University). MangroveWatch, initially hosted by the University of Queensland, also moved to James Cook University and is now hosted by the non-government organisation, EarthWatch Australia.

Aim

The aim of this guideline is to support project leaders (including scientists, researchers and community members) with the development of future GBR citizen science projects; increase awareness of the ten core principles of citizen science; and provide new knowledge and understanding that support stewardship and management of the GBR.

Principles of Citizen Science

To develop a consistent and shared approach to citizen science, the Australian Citizen Science Association has adapted and adopted the European Citizen Science Association's Ten Principles of Citizen Science (see below).

1. **Citizen science projects actively involve citizens in scientific endeavour that generates new knowledge or understanding.** Citizens may act as contributors, collaborators, or as project leader and have a meaningful role in the project.

2. **Citizen science projects have a genuine science outcome.** For example, answering a research question, informing conservation action, or facilitating policy decisions.

3. **Citizen science provides benefits to both science and society.** Benefits may include learning opportunities, personal enjoyment, social benefits, the publication of research outputs, contributing to scientific evidence that can influence policy on many scales (locally, nationally, and internationally), and connecting the wider community with science.

4. **Citizen scientists may participate in various stages of the scientific process.** This may include developing research questions, designing methods, gathering and analysing data, and communicating results.

5. **Citizen scientists receive feedback from the project.** For example, how their data are being used and the research, policy or societal outcomes.

6. **Citizen science, as with all forms of scientific inquiry, has limitations and biases that should be considered and controlled for.** However, unlike traditional research approaches, citizen science provides greater opportunity for public engagement and participation, increasing accessibility of science in society.

7. **Where possible and suitable, project data and meta-data from citizen science projects are made publicly available and results are published in an open access format.** Data sharing may occur during or after the project, unless there are security or privacy concerns that prevent this from occurring.

8. **Citizen scientists are suitably acknowledged by projects.** This may include acknowledgement in project communications, result reporting and publications.

9. **Citizen science programs offer a range of benefits and outcomes which should be acknowledged and considered in project evaluation.** Communication and evaluation of projects could include scientific outputs, data quality, participant experience and learning, knowledge sharing, social benefits, capacity building, new ways of science engagement, enhanced stakeholder dialogue, and wider societal or policy impact.

10. **The leaders of citizen science projects take into consideration legal and ethical considerations of the project.** These considerations include copyright, intellectual property, data sharing agreements, confidentiality, attribution, participant safety and wellbeing, traditional owner consultation, and the environmental impact of any activities.

While it is best practice to meet all ten principles, it is acknowledged that this may not always be possible. For example, it may not be possible to publish data for projects relating to the locations of threatened species that may be placed at greater risk should this information become publicly available. However, all projects (both new and existing) should regularly review their project methodology to ensure that these best management principles are being considered and, where possible, met. Keeping these principles in mind is a good place to start with any new project.

Part A. Before you get started

So, you are keen to start a citizen science project, where do you start? What do you need to know before discovering what you want to know?

1. Do your research

Before you start formulating your project it is a good idea to gather as much information as you can. Ask yourself the following questions:

- ✓ Is there any local knowledge about your species or ecosystem (topic)? Check in with your local community and First Nation community (Traditional Owners) to see what others may know. Your local library, university or museum may also have information if you have one.
- ✓ What else can you find out about your topic? *Google Scholar* is a great place to start if you don't have open access to scientific papers.
- ✓ Has anyone studied this species or ecosystem previously? Are there (or were there) related citizen science programs elsewhere, including other countries?

2. Get advice

While you may be keen to make a start, you can save yourself time and resources by getting some advice first. But to whom do you talk?

- ✓ Who is your local First Nations community? Are they interested in your project? Can you talk to them? Do you know how to contact them?
- ✓ If there is a similar project or someone has studied your species or ecosystem before, can you get some advice from their project leaders or scientific advisors?
- ✓ Will your project need a permit? You will need a permit if you are planning to conduct activities that involve:

a. The taking, usage, keeping or interference with cultural or natural resources in either a State or Commonwealth National or Marine Park, or

b. The species or ecological community is threatened, i.e., a Matter of National Environmental Significance (MNES) under the *Environment Protection and Biodiversity Conservation Act 1999 (Cth)* or Matter of State Environmental Significance under the *Nature Conservation Act 1992 (Qld).*

2.1 First Nations Peoples' Rights

The United Nations Declaration on the Rights of Indigenous Peoples (2007) endorsed by Australia in 2009, provides First Nations Peoples with the rights of Free, Prior and Informed Consent (FPIC) with their universal right to self-determination.

FPIC has also led to the development of Indigenous Cultural and Intellectual Property (ICIP), the rights of First Nations Peoples to their culture and heritage. ICIP incorporates:

- traditional knowledge (including traditional ecological knowledge),
- traditional cultural expression (including language),
- artistic, literary or performance works,
- tangible or intangible cultural heritage (including environmental resources),
- ancestral remains and genetic materials,

- sites of First Nations significance,
- the secret and sacred material and information, and
- documentation of First Nations peoples' heritage in all forms of media.

This has implications for the collection, storage and dissemination of data collected by, or in partnership, with First Nations Peoples that you will need to consider.

2.2 Engagement with your local First Nation community

When done well, respectful and meaningful, long-term relationships between First Nations peoples and non-Indigenous groups can help people develop cross-cultural understanding, new perspectives and new friendships, contributes to reconciliation and builds stronger, and more resilient communities.

You should try to talk to your local First Nation community about your project. Check to see if there is a local Registered Native Title Body Corporate, Indigenous Land and Sea Ranger Group or Aboriginal Corporation. If your project or activity area covers more than one formally recognised First Nation group, then you should engage with each group.

Things to consider:

Are there elements of the project that might impact the rights and interests of First Nations people? These may include rights and interests under the *Native Title Act 1993 (Cth)*, or *Aboriginal Cultural Heritage Act 2003 (Qld)*.

Remember, what may be important to you may not be important or relevant to Traditional Owners, so identify any opportunities that could arise for First Nations peoples – such as new skills or knowledge that may be gained through the program. Take the time to discuss your project with them and listen to what they may have to say – particularly site- or species-specific information if it is shared.

Agree on a process to address any matters raised in your meeting and how you plan to acknowledge First Nations communities through your project. Ensure that you maintain communication and engagement with your First Nations community as the project progresses.

3. What are the risks?

Have you thought about how you will deliver your project? Where and when would activities take place? What are the risks of people participating and how could you minimise those risks?

There are multiple risks that will apply to your project and its participants. These include safety risks, data privacy (both volunteer information and the data that you may collect through the project), youth protection (or other vulnerable people) and operational risks from running your project.

3.1. Work Health and Safety

Safe work practices will help protect your project participants, you, and your project's reputation.

Although volunteer associations *'made up of only volunteers that work together for a community purpose'* may not have to comply under the Australian Model Work Health and Safety Laws and Queensland's *Work Health and Safety Act 2011 (Qld),* they set our requirements and standards for healthy and safe workplaces. Under the Act, a business owner or entity must ensure, as far as is reasonably practicable, the health and safety of workers (including volunteers) at the workplace.

3.2. Risk Assessment

Before you commence your project, you should visit all sites to check accessibility and any risks that may need to be mitigated for you and your volunteers.

There are lots of great risk assessment and management resources available online which include Conservation Volunteers Australia's 'In Safe Hands – free safety management toolkit'.

If you are going to engage volunteers or workers in any high-risk activities, then it is recommended that you develop a **Safe Work Method Statement (SWMS).** A SWMS identifies hazards, details the measures selected to control or reduce risks and describes how the risk control measures will be implemented.

Volunteers should be provided with a safety briefing before commencing any citizen science activity.

Citizen science projects are sometimes conducted in remote areas, making emergency access and communications a challenge. You should develop an Emergency or Evacuation Plan including relevant phone numbers, emergency procedures and instructions such as where to congregate in the event of an emergency for each site, which can be communicated with volunteers during the safety briefing.

3.3. Working with Children

If you plan to involve young people in your project, then you may need a blue card for leaders and other participants that may interact with children. The blue card system regulates specific services and activities to create safe environments for children.

Organisations that receive state or federal funding may have agreements that require them to comply with working with children legislation.

3.4. Insurance

Whether your group is a small community group or a large non-profit organisation, there are specific types of insurance you will need to protect your citizen science project and yourself from potential risks. Insurance can help protect you, your volunteers and even the places that you conduct your project that may be damaged by activities.

There are several types of policy that you may need to consider, so get some specialist advice or speak to a broker to discuss what insurance best suits your needs.

If you are a community Natural Resource Management group that is an incorporated association or hosted (auspiced) by an incorporated association, then you may want to consider applying to become a member of Queensland Water and Land Carers. Membership is free and your group may also be eligible for insurance coverage including:

- Volunteer Workers Personal Accident Insurance*
- Public Liability Insurance,
- Directors & Officers Liability Insurance,
- Professional Indemnity Insurance.

*Note – this policy currently excludes in-water activities.

Another point to consider is that volunteer workers and public liability insurance are usually a pre-requisite for any funding body. So, if you are applying for funding, and are successful, they will expect you, at a minimum, to have these policies in place.

B. Developing your project

Once, you have done some preparation, you are ready to start developing your citizen science project. Bonney et al. (2009) provide a simple model for project development below:

1. Choose a scientific question
2. Form a scientist, educator, technologist, evaluator team
3. Develop, test, and refine protocols, data forms and educational support materials.
4. Recruit participants.
5. Train participants.
6. Accept, edit and display data.
7. Analyse and interpret data.
8. Disseminate results.
9. Measure outcomes.

Before you get started and choose your scientific question, you may want to consider an additional step, i.e., what it is you ultimately hope to achieve by undertaking your citizen science project – what are your goals? See Figure 2 below.

CASE STUDY 1: ADDRESSING KNOWLEDGE GAPS - GIRT SCIENTIFIC DIVER

Figure 1: GIRT Diver surveys the Aurora in Moreton Bay, Queensland (Photo: GIRT)

The GBR Outlook Report identifies several values where no condition or trend data is currently being recorded, e.g., Historic voyages and shipwrecks. These are areas where citizen science may be able to assist.

Gathering Information via Recreational and Technical (GIRT) Scientific Divers is a conservation focused no-impact citizen-science project. GIRT divers (minimum standard is 50+ logged dives) adopt a shipwreck site and after ½-day training complete data sheets including environmental conditions, questions around site formation, impacts of climate change, storm events, micro environmental changes and human activities that may impact the site directly or indirectly.

Forms and associated images/video are submitted to the Australian National Shipwrecks Database to be included in the wreck site's official record.

First trialled in Australia in 2018, GIRT was designed and developed to encourage interested people, businesses, and groups to have an active and positive underwater archaeology role through citizen science.

GIRT is a recognised program on the United Nations Decade of Ocean Science for Sustainable Development 2021-30.

Figure 2: Work through the steps to ensure that your citizen science project meets your goals and achieves its outcomes (Adapted from Bonney et al, 2009)

1. Establish your goals

What are you aiming to change? Your citizen science project may have several drivers – including **passion** for a particular species or locally significant place, **perceived problems,** or management concerns, increasing **knowledge**, education and awareness. It is important to define what it is that you want to achieve while recognising the skills and motivation of your participants.

These may include:

- Knowledge - answering a research question
- Education and engagement – involving your local community and sharing it with others
- Management - informing conservation action or supporting management change
- Stewardship - driving or increasing stewardship for a particular place, habitat or species, or
- Policy changes - supporting policy discussions and decision making.

Knowledge can also be used to provide evidence to drive management change. If you do have management concerns, then experienced project leaders suggest that you look at citizen science not only as an opportunity to increase knowledge, but through your volunteers and participants to **create** stewardship and management change.

Once you have identified your goals, check your assumptions and that your project can help address what you aim to change. One way to do this is to develop a Theory of Change (see Figure 4 below).

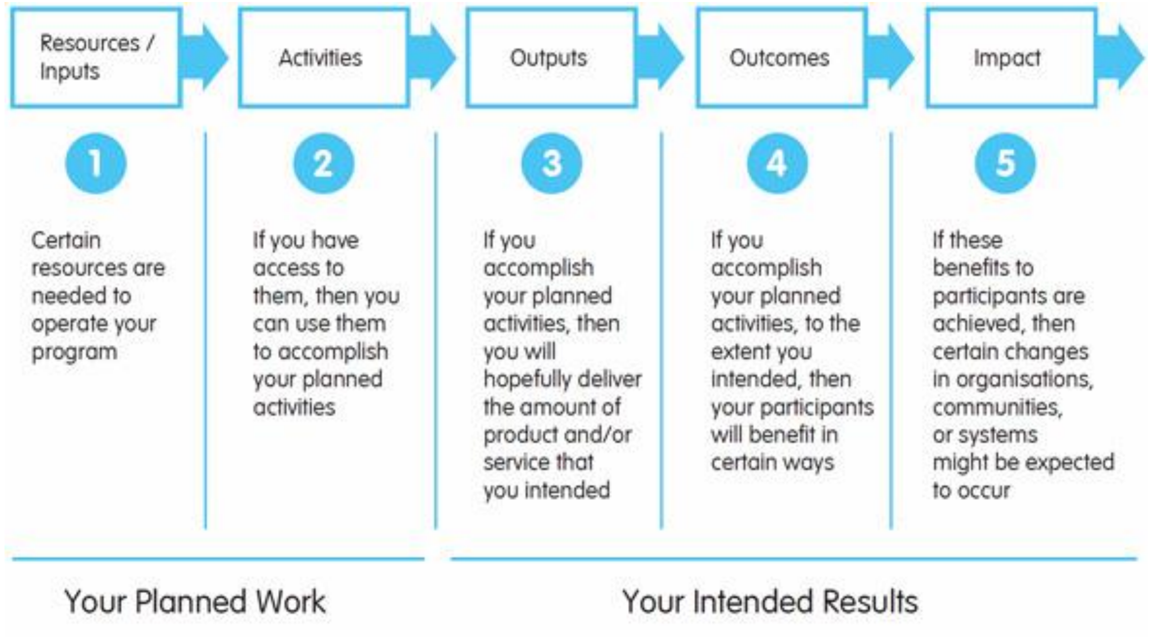

Figure 4: How to develop your Theory of Change (From - Innovation for Social Change)

2. Choose a scientific question

Ensuring that your citizen science project has a genuine science outcome is one of the ten Citizen Science principles. Developing a clear concise and scientific goal (sometimes called the hypothesis) will provide you with a purpose for your citizen science project and team.

Scientific questions must be objective, and they must be testable. There are two types of scientific questions found in citizen science projects – hypotheses and research questions. You may want to see which one aligns best to your project's goals or the knowledge that is held about the focus of your project.

CASE STUDY 2: WHAT ARE YOUR GOALS? MANGROVEWATCH

Figure 3: Mangrove Watch volunteers record the shoreline (Photo: CAFNEC)

Initially designed to monitor mangrove habitat, MangroveWatch relies primarily on assessment of video imagery of shoreline habitats collected by community volunteers and indigenous locals.

The shoreline habitat assessment methodology was developed specifically for the MangroveWatch program to ensure that data acquisition was easy, cost-effective and fun but did not require complex scientific knowledge by collectors.

As time progressed, the MangroveWatch program's goals have changed to incorporate volunteers seeking to support management change, protecting and restoring their local mangroves. Mangrove Champions is a stewardship program for volunteers actively conserving mangrove habitat.

2.1. Developing a hypothesis

A hypothesis is a statement that expresses a **possible relationship** between variables or phenomena, based on existing knowledge, theory or observation. The hypothesis outlines the expected result, which you then test through your project observations. While your citizen science project's results may support or disprove your hypothesis, you never prove your hypothesis.

Variables are the factors that you can observe or test. There are two types of variables - **independent** (the ones that can be or are changed for your study) e.g., sand temperature and **dependent** which are the ones that you observe e.g., percentage of successful turtle hatchlings.

A **simple hypothesis** is a statement that suggests the relationship between the independent and dependent variables. When writing a hypothesis, it helps to phrase it using an if-then format, e.g., If sand temperature on Queensland nesting beaches increases, then turtle hatchling success decreases.

A **complex hypothesis** statement suggests the relationship between more than two variables, e.g., If sand temperature on Queensland nesting beaches increases, then turtle hatchling success decreases and there is an increase in female turtle hatchlings.

A **null hypothesis** suggests that there is no relationship between the variables, e.g., Sand temperature on Queensland nesting beaches does not affect turtle hatchling success.

So, what makes a good hypothesis?

- ✓ Include a cause-and-effect relationship - where one variable can cause another to change (or not change if you are using a null hypothesis).
- ✓ Can you test it? Make sure you choose a hypothesis with an independent variable that you can control or will vary.
- ✓ Define your variables and use concise language to ensure that your hypothesis remains as clear and simple as possible. There should be no confusion or ambiguity about what you will be monitoring or why.
- ✓ Ensure that your hypothesis is ethical – avoid any hypothesis that may impact on the species, habitat or system that you are studying and maintains the citizen science project's credibility and reputation.

2.2. Research Question

Grounded in research, a research question seeks to provide new knowledge without assumptions. It outlines the focus of the study including the population and variables to be studied in addition to the problem or knowledge gap the study proposes to address. A research question may address an issue or problem that through the collection and analysis of data, is answered in the study's conclusion.

To develop a research question, start with a broad topic and gradually narrow your area of interest based on a literature review or preliminary research. Seek input from experts in the field, mentors and colleagues (this may also help with the development of your methodology). Develop some working questions or knowledge gaps and identify how these could be addressed through your study before refining and finalising your final research question(s).

Your research questions should be aligned to your citizen science project's objectives and anticipated outcomes. This ensures that your research remains focused and purposeful, providing actionable data and insights.

A good research question should be clear and specific, feasible, interesting, novel, ethical and relevant. This means it should be achievable, engaging, provide new insights, be ethically sound and relevant to the field of study.

While there are several frameworks that you may want to use to help you formulate your research question, examples include SPIDER and PICOT (first introduced by Richardson et al, 1995).

- SPIDER - Sample, Phenomenon of Interest, Design, Evaluation and Research type.
- PICOT – population or problem, intervention or indicator, comparison group, outcome of interest and timeframe for your study.

Research questions can also be classified further into quantitative and qualitative or mixed-method studies depending on the type of research that will be undertaken.

An example of a good research question (in three parts) would be:

What effects does exposure to beach driving by four-wheel drive vehicles have on sand fauna biomass[1] and if discontinued, how long does it take for faunal biomass to return to pre-exposure levels[2] and are there any lasting impacts on sand fauna biodiversity[3]?

3. Form a team

3.1. The Core Team (or Steering Group)

Most successful citizen science projects have a core team and call on additional supporters and volunteers where required. For smaller groups or organisations, you may want to consider partnering with a larger group, non-government organisation (NGO) or sponsoring body such as a university, your local government authority, or your local natural resource management organisation until your project is established.

A successful citizen science project needs a multi-disciplinary approach. Every citizen science project is different and so who you may need to enlist in your team will also vary. Bonney et al. (2009) suggest you 'form a scientist/educator/technologist/evaluator team' but you may also want to enlist some additional support from people with communication, engagement, project management, data management, website development or fundraising skills.

If your project aims to have your data adopted or used by another organisation, make sure to involve them from the beginning. That way you can identify common goals and ensure that any data generated by your project will be fit-for-purpose.

What skills do you need to develop your citizen science program?

- **Science or research** – a good technical advisor will ensure the project has scientific integrity. They can help develop the methodology and protocols to support the collection, management, analysis and publication of project data.
- **An educator** can help with pilot- and field-testing the methodology and the development of materials to assist with training to transfer knowledge between the scientists and project participants to reinforce the project's significance and maintain sampling standards (quality control).
- **Project management** will help maintain focus and ensure your project activities are completed on time, within budget and to an agreed standard as well as addressing issues as they arise. A project manager also takes responsibility for project risks and ensures that stakeholders are kept informed and engaged throughout your project.
- **Communications and engagement** – although this role may be filled by the educator in your team, public relations and engagement is a specialist role. A communications and engagement specialist can help by brokering stakeholder relationships and ensure that your project engages the community, influences change and enhances communication tools such as social media or your website.
- **Data analysis and management** – although for many projects this is an after-thought, but identifying how you will store, analyse, synthesise and publish your data should be important considerations from the start of your project. Storing your data on an external hard drive is not a sufficient way to maintain your data securely nor share it with your citizen science participants.

Start with yourself – what skills do you bring to the team and then reach out to your circle of friends, colleagues and contacts that you may have made through Part A of your project. A small team of 4-5 people is a good start. You may want to engage additional team members or advisors when needed e.g., a fundraiser.

Continuously having to apply for funds consumes time and resources. When surveyed as part of the GBR Citizen Science project, everyone acknowledged the challenges of fundraising, although there were mixed opinions about the value of fundraisers. Fundraising is a specialist skillset with one interviewee suggesting paying fundraisers doesn't work, and another suggesting that if you are going to hire a fundraiser do it early and get a good one! Finding a fundraiser that is aligned to your goals and project outcomes is ideal. Others suggested establishing a program that was sustainable or had a platform that that could draw in untied funding rather than grants to maintain an income.

3.2. Volunteer Recruitment

Who do you want to participate in your project? If your goal is to establish a longer-term citizen science project with stewardship goals, then you may want to consider youth engagement and inter-generational change from the outset. Link or embed programs into schools and Science, Technology, Engineering and Mathematics (STEM) to help build a new generation of scientists that care about the environment and influence inter-generational behaviour change.

Once you are ready to launch your citizen science project you can use various tools to attract volunteers. These include a dedicated project website, social media (such as Facebook, Twitter, Bluesky, LinkedIn and Instagram), and listing your project with citizen science search engines such as SciStarter Australia or Atlas of Living Australia.

Social media is a great tool for promoting your project. You can create groups, events, posts and you can share them far and wide by tagging others (@) or adding a hashtag (#), adding co-hosts to your events and projects (Facebook) and by posting or sharing your event in relevant forums and local community pages. Contact ACSA to help promote your post through their online community and regional chapters or tag them @AustralianCitizenScienceAssociation.

If you are going to use social media, be aware that different social media appeals to different age groups. If you are trying to attract a certain age group of volunteers, you should match your social media to their profile. Millennials (born 1981 to 1996) are the most active demographic on social media, with 68.8% of them estimated to be using social media in 2024. In terms of daily time spent on social media, Gen Z (born 1996 to 2010) tops the list with 35% using it more than two hours a day.

While there are free website builders available that are relatively easy to use, such as WordPress, Wix, Yola and many others, there are additional factors that you may want to consider in your website design at the outset – such as how you plan to share your data and accessibility. Will the website allow a plug-in making it available in multiple languages should you upscale or expand your citizen science project overseas? Having a website can greatly increase your professional outlook, however there may be associated costs such ongoing hosting or web support.

Depending on where you live, you can also use community networks such as local Landcare, Coastcare or other community groups such as Lions or Rotary, or schools and universities. Many students are already learning and may want to gain more fieldwork experience, so educational institutions are a great place to find interested volunteers. You could drop off flyers at your local library, cafes or man a stall at the local community event or market. Community noticeboards (actual and online) are also a good option in some communities.

Don't forget your local media – such as local radio or newspapers (online and print). Most are highly supportive of citizen science and community initiatives so write a media release about your project (max. 1 page) and check to see if they would like to interview you or write an article about your citizen science project. Remember they are looking for news, so try and include any interesting facts and why the community may be interested in participating.

Finally, you may want to start with a community event or project launch and invite interested people to attend to find out more before signing up. Be honest and identify the project's goals, any specialist skills (e.g., divers), previous experience or restrictions (e.g., age, health or mobility) on participants, as this will save a lot of frustration later.

If your goal is to establish a longer-term citizen science project with stewardship goals, then you may want to consider youth engagement and inter-generational change from the outset. Link or embed programs into schools and STEM to build a new generation of scientists that care about the environment and influence inter-generational behaviour change.

Before you commence your citizen science project, you may want to consider:

- How many citizen scientists will you need to deliver your activity?

- What are your expectations of your volunteers in terms of contributing to your project in terms of hours per month, but also the projected length of your project in years?
- What specific activities will they be doing to collect citizen science data?
- How you will train your citizen scientists, supervise activities and monitor their data collection to ensure that the data collected is accurate and reliable? This is sometimes referred to as quality assurance and quality control or QA/QC.

Once you have attracted a cohort of volunteers, you may need to further screen them for suitability for your project team. The need for screening largely depends on the possible risk to others, but some screening is also determined by legislation e.g., working with children which is driven by the *Working with Children (Risk Management and Screening) Act 2000* (Qld) with the requirement for a Blue Card.

Will your volunteers have access to sensitive information or intellectual property? If so, then you may also need them to sign a confidentiality agreement.

If the screening process identifies information that excludes the volunteer, you will need to advise the person that their application has been rejected.

3.3. Volunteer records

Once your project commences, you should maintain project records for citizen science participants to identify any skills or training undertaken and records of their volunteer contributions and achievements.

Records should include documents such as:

- Volunteer application form (or interview)
- Blue card number (if applicable)
- Volunteer training

CASE STUDY 3: METHODOLOGY SELECTION

Figure 5: Reef Check Australia empowering local communities (Photo: Reef Check Australia)

Check to see if there is already a methodology for your selected species or habitat. In some cases, e.g., coral monitoring, there may be multiple methodologies to select from.

Reef Check surveys are conducted along a transect line marked by a graduated tape measure that is laid along a constant depth and reef habitat. The transect length that is surveyed is 80m, divided into four 20m sections or transect replicates.

Reef Life Survey is a citizen science program in which trained SCUBA divers undertake standardised underwater visual surveys of reef biodiversity on rocky and coral reefs around the world to monitor biodiversity status and trend. Survey methods involve divers recording fish and invertebrate species seen along the underwater transects.

CoralWatch integrates global coral health monitoring with education and public outreach creating reef awareness using simple and engaging tools. This provides people with accessible information about coral reefs and climate change, and hands-on experience collecting scientific data on coral bleaching using the Coral Health Chart.

The Eye on the Reef Photo Point project uses geo-referenced underwater photographs and artificial intelligence to bridge the gap between tourism citizen science staff and dedicated marine science.

Check what happens to project data before making your final selection.

- Volunteer induction documentation
- Privacy policy
- Volunteer agreement
- Confidentiality agreement
- Records and reports of volunteer contributions and achievements
- Volunteer management processes or systems
- Feedback from clients, staff, or community.

Volunteer records help track volunteer contributions (in-kind support), support Workplace Health and Safety and provide background information for volunteer references if requested.

4. Develop Protocols and Data Forms

As previously stated, data quality assurance is a critical component of any citizen science project. Your project will depend on providing:

a. A clear and concise methodology to support your citizen science project participants with data collection protocols (see also Great Barrier Reef Citizen Science Data Standards).
b. A simple data collection form (or App.) that is logical and easy to follow.
c. Instructions on how to upload or submit their data once their survey has been completed.

You may also want to provide additional materials to support your volunteers or enhance their learning and participation. These materials include identification guides, posters, manuals, videos, podcasts, and newsletters. These materials can also be shared on your website once it is available.

4.1.Methodology and Protocols

If there are existing monitoring or data protocols related to your citizen science project or study, you may want to use or adapt this methodology to provide consistency for

CASE STUDY 4: THREATENED SPECIES

Figure 6: A marine turtle is satellite tagged to increase knowledge that contributes to conservation

Citizen scientists can provide quality data for threatened species including projects to support outputs for IUCN Assessments.

Whether you provide presence/absence data or undertake more detailed assessments like the distribution and abundance patterns of four species of sawfishes, like Sharks and Rays Australia (SARA) you can contribute to the conservation of threatened species.

In 2015, SARA started an assessment of the current distributions and abundance patterns of four species of sawfishes in Far North Queensland and the Cape York Peninsula. This study is ongoing, and regions are continually expanded into different regions in collaboration with local Indigenous Land and Sea Ranger groups.

If you are a keen birdwatcher, then Queensland Wader Study Group has undertaken several surveys of migratory waders counting the shorebirds on high tide roosts along almost the entire Queensland coast. Surveys have been undertaken since the early 1990s.

Commencing in the 1970s, the Queensland Turtle Conservation Project involves research and monitoring of freshwater and marine turtles. Citizen scientists monitor nesting turtles to gauge the success of management interventions, such as Turtle Exclusion Devices on commercial fishing nets undertaken decades earlier.

your data. The project methodology states when, where and how your citizen science data should be collected.

Protocols are rules that must be followed when collecting data – e.g., rinse equipment twice before use. Another common protocol is when using transects and quadrats whether you include or exclude species that touch the edge of the quadrat. Remember that your methodology will be used by a range of volunteers and that it is important that the tasks should be simple, easy to perform and replicable by all participants.

Gallagher at al. (2024) have suggested that citizen scientists can help address the current extinction crisis by 'raising awareness, identifying species occurrences, assessing population trends and informing direct management actions.' One way that this can occur is to design citizen science projects to support outputs for IUCN Assessments. These include:

- Occurrence data - species records that typically include spatial coordinates and temporal information, supported with an image or sound recording for verification.
- Presence-absence observations – providing evidence that a species has or has not been recorded at a specific location.
- Structured surveys of a target species – which may also include tasks such as counting individuals (abundance), sex or age classes or recording the presence of threats at a designated site.
- Physical samples – collecting samplers such as scat at a designated site.
- Narratives – through collected stories or oral histories.

It is suggested that once you have a draft methodology that you field test (pilot) it with 2-3 small groups of volunteers. Without providing additional support, observe how they interpret the methodology, collect and submit their data and collect feedback to identify where there may have been any confusion or suggestions for improvement. Incorporate this information into any revised methodology and check it with your field test group.

One thing that it is important to discuss with your volunteers is the value of their data. In recording data, a zero result can be just as important as a result with data, this is particularly true when undertaking threatened species surveys. It is important that volunteers do not bias their results. There are several types of bias that can impact results:

- Confirmation bias - when we favour information that confirms our existing attitudes or beliefs.
- Historical bias – when we allow previous monitoring events to influence what we record or exclude in subsequent monitoring activities.
- Selection bias – when samples are not chosen randomly, and the data may be skewed or unrepresentative.

Citizen scientists that can follow the methodology, protocols and avoid biasing their results, will be able to record the most accurate and useful data.

4.2. Data Collection Form

Identify all the information that you want your citizen science participants to collect. Check that all the data being collected will contribute to your citizen science project or linked activities.

Designing a data form is best undertaken with the methodology and protocol development. A good data form will reflect the project methodology and help prepare data for analysis. Adding a field for volunteers to add additional comments can help identify when follow-up will be needed.

Online applications or apps are becoming more common with the advantage that participants can be prevented from submitting their data before all the required fields are completed.

Pilot your data sheets with the methodology and protocols and refine as needed.

4.3. Instructions on how to submit or upload data

Do not forget to provide instructions on how to submit or upload data in your methodology. For example, should data sheets be emailed, uploaded, or physically dropped off to the project leader. Using apps, this can be as simple as a submit button.

5. Training Citizen Science Participants

Training is an important component of every project and represents a major commitment to citizen science participants by project leaders. Training may also be the first opportunity to assess and vet your volunteers for their suitability in the field.

Training is also a great opportunity for project leaders to identify natural leaders within the training group – these are the people that may be willing to increase their skills or to supervise others.

"What I do is focus on training everyone in that cohort and identify anyone who may be a super-volunteer or a volunteer and to see what I can do to help those volunteers step up to being able to become a super-volunteer, breaking down those barriers to their participation."

Be aware that different people may have different learning styles or understanding new information. This is the way a person takes in, understands, expresses and remembers information. There are four predominant learning styles:

- Visual – learn by seeing
- Auditory – learn by hearing
- Read/write – learn by reading and writing (or note taking), and
- Kinaesthetic – learn by doing.

Unless you know all your trainees well, you should try to provide opportunities for all learning styles in your training. Provide support information such as written materials or videos to participants with enough time to study and review materials. Trainees must take responsibility for reading and studying project materials and for calling or e-mailing the project leader for additional help if necessary.

Training workshops provide an excellent opportunity for both volunteer training and education. Although not all trainees may convert to project volunteers, they may promote the project to others or consider the project later when life or circumstances allow.

6. Accept, edit, and display data

Whether you use paper-based, electronic, or web-based data entry, it is important to review all data before it is accepted and uploaded to the dataset. This process is sometimes referred to as 'data cleaning,' and includes fixing or removing incorrect, corrupted, incorrectly formatted, duplicate, or incomplete data within a dataset.

Displaying your data is an important way to communicate your project and encouraging participants and others to manipulate or study raw data is an important component of citizen science.

Increasingly, online tools may also provide you with options to automatically display your data. Examples of this include the Atlas of Living Australia, iNaturalist and eOceans platforms.

Although, the timely release of data may be critical for threatened species protection and conservation, caution should be exercised in displaying any information relating to the specific location of threatened species.

Access to threatened species data should be consideration during the project design process and should also be a consideration for agencies granting research permits in terms of private versus public benefit of research. Data embargoes on research may mean that data is not released until after publication which can be 2-4 years (or more) after it was collected – by which time it may be too late to implement management change.

There are options to disguise threatened species such as data truncation to 1d.p. or 'jittering' to create random noise e.g., within a Marine Protected Area. Historically on iNaturalist, taxon geoprivacy has been applied somewhat idiosyncratically to Australian taxa, with a combination of IUCN Red List threatened species statuses, federal and state sensitive species statuses, and in-platform discussions among local experts all contributing to obscuration. Recent changes have been made to apply obscuration to Australian taxa more consistently and align location sharing with the National Framework for Sharing of Restricted Access Species Data in Australia (RASD; Atlas of Living Australia 2023).

iNat Taxon geoprivacy. Taxa that are deemed to have sensitive locations have their coordinates automatically obscured when an observation is uploaded, or when an identification of that taxon is added to any observation. This is a measure designed to mask the true locations of sensitive taxa and reduce the possibility of potential negative consequences of location disclosure, e.g., rare species being poached, or small threatened plants having their habitat trampled. When an observation is obscured, two changes occur:

a) The true coordinates are removed from public view and replaced with a randomly generated set of coordinates within a 0.2° x 0.2° grid cell (~500 km^2 at the equator) around the true coordinates. The positional accuracy is therefore increased to the diagonal of this cell, equalling ~24-31 km (depending on latitude). On individual observations, this grid cell is represented by a bounding box on the map, and the marker shown on the map is the randomly generated point.

b) The date and time are removed from public view so that only the month and year are visible. The date/time are also generalised for each added identification, and locality notes are changed to only indicate the state and country.

The true coordinates are available to the observer and individuals that the observer has trusted with their hidden coordinates.

7. Analyse and Interpret Data

Citizen science projects can result in large temporally and spatially diverse datasets, the analysis of which can be a time consuming and challenging task for project leaders.

Good project design can assist in the analysis and interpretation of data. Some data analysis may be automated using tools like Excel. But this is where it is important to call upon your scientists and researchers on the team.

One challenge for data analysis for researchers is the drive for publications, which is a key performance indicator for most universities and research organisations. Data analysis and publication may take several years with a general embargo on publishing or sharing data until the information is published.

Another challenge are the costs associated with data analysis and publication, which may occur several years after projects are established or after funding support has been provided.

8. Disseminating Results

If raw data cannot be released, collated, or synthesised data should be made available to citizen science participants along with feedback on how their data are being used and any research, policy or other outcomes from their participation.

Where possible and suitable, project data and meta-data from citizen science projects should be made publicly available and results published in an open access format. Data sharing may occur during or after the project unless there are security or privacy concerns that prevent this from occurring.

8.1. Data Management Documentation

Quality assurance and quality control (QA/QC) are often given as the reason there is an element of distrust in citizen science data. While many citizen science projects implement one or more quality assurance mechanisms, these practices are poorly documented and publicised (de Sherbinin et al. 2021).

Thuermer et al. (2023) suggest that Data Management Documentation (DMD) or Data Management Plans (DMPs) can increase understanding and trust in citizen science data, improve data quality and accessibility, and increase the reproducibility of experiments.

A DMP defines the relationship between the different participants involved in data management and responsibilities e.g., data collection, cleaning, and analysis. They outline how the project host, staff and citizen scientists work with the data, and how external researchers, policy-makers and other companies can interact with it. While a DMD is recommended best practice, they are not currently common within the citizen science sector with groups outside of academic data management lacking awareness of tools to support their development.

An example Template for Citizen Science Quality Assurance and Documentation is provided from the United States Environmental Protection Agency (2019).

8.2. Data Use Agreement

Third-party researchers, entities, and government organisations may request access to data not owned or contributed by them individually. Any request for access must be carefully considered in terms of contribution towards the citizen science project's goals and must fully acknowledge the contribution of the project's volunteers or individual contributors.

Where projects are conducted in partnership with First Nations peoples, additional consideration must be made of Indigenous Cultural and Intellectual Property (ICIP).

A Data Use Agreement is a legally binding document that outlines the terms and conditions of sharing data between two parties. The agreement specifies what data can be shared, for what purpose, the obligations of both parties and what happens if the agreement is breached.

9. Monitor and Evaluate Outcomes

In keeping with any continuous improvement process it is important to review the project at its completion (or more regularly for ongoing projects) to ensure that both the citizen science project's goals and scientific objectives have or are being met and that learnings are shared with participants, supporters and more broadly with the sector to inform future projects.

Project goals such as engagement and participation can be evaluated through the project records or. Evaluation measures include:

- Number of volunteers
- Number of volunteers trained
- Number of citizen science activities and number of participants
- Volunteer contribution in participant days
- Number of sites monitored and number of citizen science surveys completed.

Participant Knowledge, Attitudes, Skills, and Aspirations (KASA) can be evaluated regularly through pre- and post-surveys of project participants.

Bonney et. al (2009) suggest measures of scientific contributions including:

- Numbers of papers in peer-reviewed journals (and citations of results).
- Numbers of researchers publishing citizen science research papers,
- Number and size of grants provided for citizen science
- Size of citizen science databases,
- Number of graduate theses completed using citizen science data and
- Frequency of media exposure of results.

Finally, contribution to the project's goals e.g., stewardship, behaviour change, management or policy change are reviewed. Evidence-based, project leaders should assess both short- and long-term outcomes to assess the citizen science project's success.

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Appendix 1: Guidelines for Volunteers

If you are looking for a quick go-to guide for people interested in becoming a citizen science volunteer, you may want to use or adapt this list.

1. Find a Citizen Science project and group in which you are interested. Find out more, do you know anyone else in the group?
2. You may want to start right away, but training is important. Make sure that you can commit to any training that may be offered – these are often great ways to learn more and to meet like-minded people.
3. If you are unsure, don't be afraid to ask questions. If you think about the value of the data that you are collecting – organising the data collection, weather, hiring boats or specialised equipment, then your question is important.
4. Stick to the methodology – if you don't, then you may invalidate your data and the project's results.
5. Record what you see and not what you hope to see. A zero result is still important data.
6. Have fun! You are important to the project team, so your Project Leader would love to see you again.