Great Barrier Reef Citizen Science Data Standards

Recording where plant, animal and ecological communities are located and where activities to protect, conserve or monitor these species and communities are delivered is increasingly important in building an understanding of how natural and anthropogenic activities may be impacting the Great Barrier Reef (GBR).

There are multiple research and citizen science programs generating data that aim to document the 9000 plus species and a range of ecological communities on the GBR.

If you are aiming for your citizen science data to be used by GBR managers and researchers, then consider the needs of these end users and ways to make the data accessible, standardised, relevant at different scales, and suitable for multiple analyses.

To do this, data sets can be designed to consider likely key standards that are outlined in this document.

Reef Data End-Users

Reef 2050 Integrated Monitoring and Reporting Program (RIMReP)

The GBR already has an extensive Data Management System for the Reef 2050 Integrated Monitoring and Reporting Program (RIMReP). Launched in 2024, this fit-for-purpose Data Management System (DMS) that underpins management and supports better understanding of what's happening on the GBR. The DMS is also supported by an online access point for the RIMReP, with parts of it accessible to the public.

It provides a 'first stop shop' or portal, linking to monitoring information drawn from multiples sources, links to Program partner systems and interactive maps and information.

The program's knowledge system is intended to enable the early detection of trends and changes in the Reef's environment to guide day-to-day decisions, shape strategic policy and inform future Great Barrier Reef Outlook Reports.

The knowledge system will evolve in response to changes in the GBR's condition, new science and technologies, and high priority needs of management and stakeholders.

Reef Report Cards

In addition to RIMReP, five regional report cards have been established that detail local waterway conditions and report on social, cultural, economic health and stewardship indicators.

These are the:

1. **Wet Tropics Healthy Waterways Partnership** - formed in 2015, involves industry, community organisations, research institutions and all levels of government. The Partnership's objectives are to coordinate the sharing of data, prioritise management actions and communicate (knowledge and results) to the broader community.
2. **Townsville Dry Tropics Partnership for Healthy Waters** - formed in 2018, is a collaboration involving community, industry, science, and government – partnering to improve the values of the catchments and Reef.

3. **Mackay-Whitsunday-Isaac Healthy Rivers to Reef Partnership** - formed in 2014, involves partners from community, Traditional Owners, industry, science, tourism and government working together to determine how and where more can be done to look after local waterways.
4. **Fitzroy Partnership for River Health** - formed in 2012, is a collective of agriculture, resources, industry, government, research and community interests across the Fitzroy Basin. Partners have a common goal of providing a more complete picture on river health and support this goal by providing funding, resources and contributing water quality and ecosystem health monitoring data through data-sharing arrangements.
5. **Gladstone Healthy Harbour Partnership** - formed in 2013, includes community members, traditional owners, industry, science, government and harbour management. The report card is an independent report that assesses the environmental health of Gladstone Harbour and the social, cultural and economic health of the Gladstone local government area.

In addition to RIMReP and the Report Cards, there are many other places where your data may be useful or relevant. These include:

- Researchers in universities, CSIRO, Bureau of Meteorology (BOM), Integrated Marine Observing System (IMOS), and Australian Institute of Marine Science (AIMS).
- International UN agencies, e.g. International Union for the Conservation of Nature (IUCN).
- Federal government agencies, including Great Barrier Reef Marine Park Authority (GBRMPA) and Department of Climate Change, Energy, the Environment and Water (DCCEEW).
- Queensland government agencies, including the Department of Environment, Tourism, Science and Innovation (DETSI), Queensland Parks and Wildlife Service (QPWS), Department of Primary Industries (DPI).
- Museums and state heritage organisations.
- Local governments in the GBR region.
- NRM groups in the GBR region.
- Indigenous Land and Sea Ranger or local First Nations groups.
- Local conservation groups and other environmental non-government organisations (NGOs).
- Online citizen science platforms, e.g. Atlas of Living Australia, iNaturalist, and WildNet.
- Industry groups, e.g. ecotourism operators, and resorts.

Key Criteria for Consideration

Spatial Data

Central to the success of these standards is the need to provide spatial data to enable information to be aggregated into a single spatial database.

The initial collection, collation, and reporting of output data is the responsibility of your citizen science program. Sites where data has been collected can be captured as a polygon, line or point feature. Each output should be associated to a description of the associated spatial feature.

Spatial Data Metadata

Spatial data submitted with output data must be accompanied by a metadata statement consistent with the guidelines developed by the Australian and New Zealand Land Information Council (ANZLIC). In accordance with the National Metadata Directory System, a set of

mandatory core metadata elements are required. Any additional information that is deemed relevant to interpret the data supplied should also be provided in an accompanying document.

Data Accuracy

Spatial data should be as accurate as possible, For the purposes of mapping, the underlying data is usually mapped at 1:25,000. However, positional accuracy should provide a reasonable guide to the location of your activities and be sufficient to distinguish the location of one site or activity to another.

Data Verification

All data submitted should be checked and verified by a technical or scientific specialist. This is a normal step in data management, sometimes referred to as *data cleaning* – the process of fixing or removing incorrect, corrupted, incorrectly formatted, duplicate, or incomplete data within a dataset. Only species and ecological community information that meets the standards and are approved by reviewers should be accepted. Any records that require further information or clarification should be reviewed by the project manager and participants to check and resubmit.

Common Attribute Data for Observations

Below is a table and description of common attributes data required for each species and ecological community observation. It is noted that special consideration must be given to data relating to threatened species either listed under the *Environment Protection and Biodiversity Conservation Act 1999 (Cth)* or *Nature Conservation Act 1992 (Qld)*. While it is critical to provide accurate data that contributes to the protection, conservation and management of threatened species and ecological communities, spatial data relating to these records should only be shared with approved Commonwealth or Queensland Government entities.

The Darwin Core Standard (DwC) provides a flexible framework for compiling biodiversity data from varied and variable sources. Originally developed by the Biodiversity Information Standards (TDWG) community, Darwin Core is 'an evolving community-developed biodiversity data standard'. It plays fundamental role in the sharing, use and reuse of open-access biodiversity data available through GBIF.org.

Table 1: Common data protocols for attributes collected by Great Barrier Reef citizen science projects

Attribute	Description	Source	Links
Project ID	Use a unique identifier for each citizen science project – this may need to be discussed with the data recipient.	Negotiated between citizen science project leader (data provider) and data recipient	
Project name	The name of your project. Projects are typically survey based with one or more surveys grouped together and operating under your project. If your citizen science project doesn't have a name you may want to consider including: • Subject - name of species or ecological community • Location • Lead organisation • Year (if the project is short-term or limited)	Citizen science project leader	https://dwc.tdwg.org/list/#dwc_datasetName
Project description	A brief description of the project (25 words or less)		
Observer name	Name(s) or unique character sequence to identify an individual participant in your citizen science project.		http://rs.tdwg.org/dwc/terms/recordedBy
Site name	Location where your data was collected e.g., Shark Bay, Heron Island. If you are undertaking several surveys or transects in the same location then this information should also be used in the site name field, e.g., Shark Bay, Site 1, transect A.		http://rs.tdwg.org/dwc/terms/version/locality-2023-06-28
Site location	Used to clarify the site name. The nearest town or major geographic feature and distance and direction to the named site, e.g. 500m east of Johnson Park, Lucinda.		http://dublincore.org/usage/terms/history/#Location-001
Coordinate system	Provide the type of coordinates used to record the site location. These should be one of the following: • Lat/long – latitude (N-S) and longitude (E-W) in degrees, minutes and seconds. • Decimal degrees		http://rs.tdwg.org/dwc/terms/verbatimCoordinateSystem

Coordinate datum	A datum is a system which allows the location of latitudes and longitudes (and heights) to be identified onto the surface of the Earth - i.e. onto the surface of a 'round' object. There are several standard datums: GDA94 or GDA2020 (Geocentric Datum of Australia), WGS84 (used by GPS satellite navigation systems and on most hydrographic charts), and AGD66 (Australian Geodetic Datum).		https://www.icsm.gov.au/education/fundamentals-mapping/datums
x Coordinate	This number represents the Longitude or Easting value for the site according to the coordinate system being used i.e., Lat/Long 148°57'50.244"E or Decimal degrees 148.96397955723808 is the x-coordinate for Pinnacle Point Lighthouse on Hook Island in the Whitsundays.		http://rs.tdwg.org/dwc/terms/verbatimCoordinates
Y Coordinate	This number represents the Latitude or Southing value for the site according to the coordinate system being used i.e., Lat/long 20°03'42.9129"S or Decimal degrees -20.061921181109128 is the y-coordinate for Pinnacle Point Lighthouse on Hook Island in the Whitsundays. The negative sign denotes that the location is found in the southern hemisphere.		http://rs.tdwg.org/dwc/terms/verbatimCoordinates
Spatial accuracy	A numeric value in metres of the potential error associated with the x-y coordinates. GPS-enabled smartphones are typically accurate to within a 4.9 m radius under open sky. However, this accuracy worsens near buildings, bridges, and trees.		http://rs.tdwg.org/dwc/terms/coordinateUncertaintyInMeters
Survey event	An identifier for the set of information associated with an individual survey event or activity. This can be built from the sampling protocol and survey date, e.g., saltmarsh survey summer 2024.		https://dwc.tdwg.org/list/#dwc_eventID
Start date	The date when the survey was undertaken using the system dd/mm/yyyy. For some projects, the time you collect the data may also be important. If this is the case, you should use the 24-hour clock i.e., 2pm is represented as 14:00.		http://rs.tdwg.org/dwc/terms/verbatimEventDate
Survey Method	A brief description of the sampling methodology and techniques used in your project. You may want to provide a link to your full methodology if this is available online.		http://rs.tdwg.org/dwc/terms/samplingProtocol

Sampling effort	If not defined by your project's methodology, you should provide an estimate of effort to undertake your survey. E.g., Number of observers = 3, or area sampled 50m x 50m.		https://dwc.tdwg.org/list/#dwc_samplingEffort
Citizen Science Data (data collected depends on the individual project)			
Ecological community or habitat name	Under the EPBC Act Ecological Communities are defined as 'The extent in nature in the Australian jurisdiction of an assemblage of native species that inhabits a particular area in nature'. If your project relates to a particular habitat or ecological community, this should be described.	Citizen science project leader/ participants	https://www.dcceew.gov.au/environment/biodiversity/threatened/communities
Species observed	This is made up of the Scientific Name, Common Name and associated WildNet Taxon ID, e.g., *Pristis zijsron* (green sawfish) 22613		https://apps.des.qld.gov.au/species-search/
Type of Record	Type of observation used to identify species: • Captured • Photographed • Seen • Heard • Scat or other evidence		http://rs.tdwg.org/dwc/terms/HumanObservation
Count	The number of each species present and identified at the time of the observation. This field may be substituted with a presence/absence field. A zero result should be recorded for any surveys of targeted species to denote the survey effort associated with surveys related to the species.		http://rs.tdwg.org/dwc/terms/individualCount
Length or size	For some species like fish, length or size can be an indication of maturity or gender. This measurement should be provided in cm or m (depending on the species).		http://rs.tdwg.org/dwc/terms/MeasurementOrFact
Sex (if known)	For sharks, rays and some fish it is possible to visually assess gender in situ. If the project relates to a specific species, then recording this data may assist with population studies or in determining gender-specific use of habitat.		http://rs.tdwg.org/dwc/terms/sex
Hatching and emergence success	Determining clutch sizes, along with nest hatching and emergence success rates, provides important data on the reproductive effort of the marine turtle nesting population. Hatching success describes the		

	proportion of eggs that produce live hatchlings. Emergence success refers to the proportion of hatchlings that reach the beach surface. Both values are expressed as a percentage (%).		
Additional information	A descriptor providing significant information relating to the observation e.g., nesting, breeding, invasive, diseased.		http://rs.tdwg.org/dwc/terms/behavior
Physical-chemical monitoring (e.g., water quality)			
Temperature	This parameter is required for accurate determination of pH, electrical conductivity and dissolved oxygen. Measured in °C.	Citizen science project leader/ participants	https://environment.desi.qld.gov.au/__data/assets/pdf_file/0031/89914/monitoring-sampling-manual-2018.pdf
pH	Measures the acidity or alkalinity of the water with a range of 1 (acidic) to 7 (neutral) and 14 (basic or alkaline). There are no units for pH.		
Dissolved oxygen (DO)	DO is reported in units of milligrams of oxygen gas (O_2) dissolved in each litre of water (i.e. mg/L) or as a percentage of the maximum amount of DO that is possible in a waterbody at a specified temperature and salinity (% saturation).		
Electrical conductivity (EC)	EC or conductivity measures the ability of water to conduct an electrical current due to the presence of dissolved salts. Thus, EC is used to calculate salinity and the concentration of dissolved salts in a waterbody. The formal unit for conductivity is siemens per metre (S/m), however micro siemens per centimetre (µS/cm) is more commonly used when measuring fresh or brackish waters, and milli siemens per centimetre (mS/cm) when measuring estuarine and marine waters.		
Salinity	Salinity is the measure of the dissolved salt content of a body of water. Salinity is generally measured in parts per thousand (g/L).		
Turbidity	Turbidity is a measure of the presence of soluble, suspended and colloidal particles that hinder the transmission of light through water. Turbidity can be measured directly using probes and is typically expressed using Nephelometric Turbidity Units (NTU).		
Total dissolved solids (TDS)	TDS include total dissolved salts but also non-ionised species (e.g. sugars, other organics and colloidal particles). TDS is usually expressed in parts per million (ppm) or milligrams per litre of water (mg/L).		
Transparency (or visibility)	Transparency is a measure of how far light can pass through water or how deeply sunlight penetrates through the water. Transparency can be measured using a Secchi disc. A Secchi disc reading is usually		

	expressed in centimetres (cm) but can in clear waters be several meters.		
Threat monitoring (e.g. coral bleaching or marine debris)			
Coral Bleaching	Many stressors can cause corals to bleach, including storms, disease, sediments and changes in salinity. However, the primary cause of regional, or *mass*, bleaching is increased sea temperatures. Mass coral bleaching events do not necessarily affect all reefs equally. Bleaching is usually expressed as a percentage (%) of the total reef habitat within the study area. This value may be further clarified by the severity of bleaching observed i.e., minor (<5% of coral cover bleached), prevalent (>10%), medium (11-30%), high (31-60%), very high (61-90%) and extreme bleaching (>90%).	Citizen science project leader/ participants	https://www.aims.gov.au/research-topics/monitoring-and-discovery/monitoring-great-barrier-reef/reef-monitoring-sampling-methods
Crown of thorns starfish	Outbreak status is assigned to all actioned reefs. It is calculated as the average number of crown-of-thorns starfish recorded across all manta tow surveys conducted at each reef and it is expressed as crown-of-thorns starfish/tow (2,000 m^2 survey area).		https://www2.gbrmpa.gov.au/our-work/programs-and-projects/crown-thorns-starfish-management/crown-thorns-starfish-project-dashboard
Litter and marine debris	There are a range of approaches used to monitor different site types e.g., waterways, shorelines or underwater. For monitoring purposes, every item larger than 5mm is counted and classified according to the Australian Marine Debris Initiaitive methodology. Data is expressed as a mass (Kg) or as a count (total number of pieces) depending on the methodology.		https://tangaroablue.org/monitoring-methodology/

References:

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