

The Great Australian Wildlife Search

Large-scale biodiversity assessments
using eDNA metabarcoding and citizen
scientists

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EnviroDNA

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“Citizen Science”

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The Australian Citizen Science Association defines citizen science as: **public participation and collaboration in scientific research with the aim to increase scientific knowledge.**

The “10 Principles of Citizen Science”

...According to the



...far too much to cover in this talk, but a good guideline

- Citizen science actively involve citizens, has a genuine science outcome, and provides benefits to **both** science and society.
- Citizen scientists receive feedback from the project, and where possible project data are made publicly available.
- Legal and ethical considerations for citizen science projects are considered

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, and provides benefits to both science and society. Citizen science projects can be used for a wide range of purposes, including research, informing conservation action, or

education, personal enjoyment, social engagement, and many scales (locally, nationally, internationally).

3. Citizen scientists receive feedback from the project, and where possible project data are made publicly available. Citizen scientists should be given the opportunity to provide feedback on the project, and where possible project data are made publicly available.

4. Legal and ethical considerations for citizen science projects are considered. Project leaders should consider legal and ethical considerations for citizen science projects, including data sharing, confidentiality, attribution, participant safety and wellbeing, traditional owner consultation, and the environmental impact of any activities.

5. 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.

6. 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.

7. 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.

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eDNA and Citizen Science – Potential for Symbiosis

Advantages

- Simple sampling methods
- Existing pool of citizens interested
- Less funding going to sampling
- More sampling = better geospatial, temporal spreads
- Data easily translatable to general public

Challenges

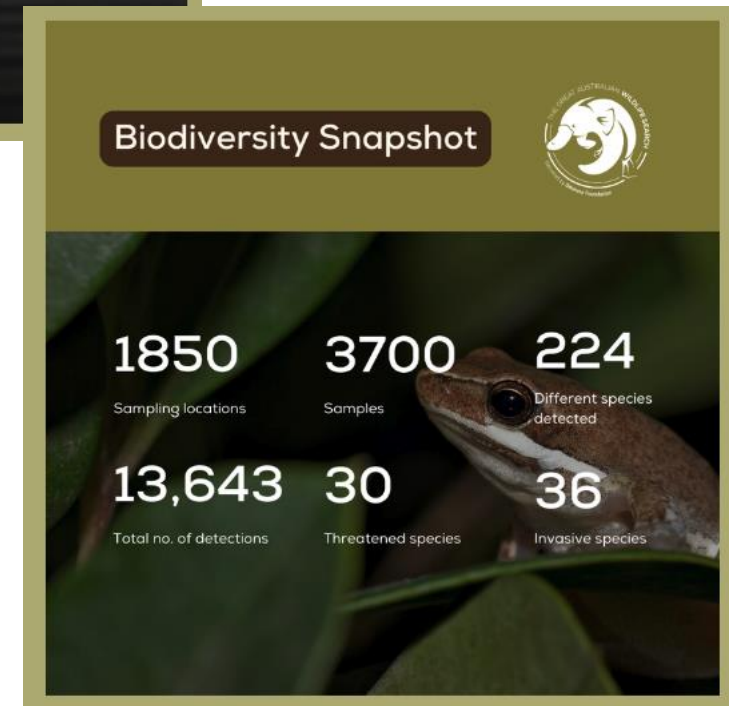
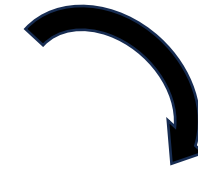
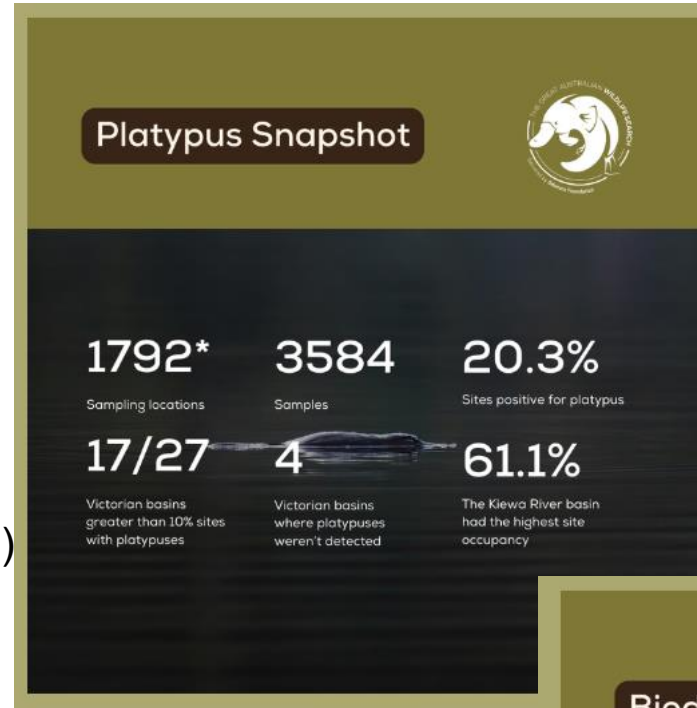
- Science you can't see – hard sell?
- Reaching new audiences
- Safety of citizen scientists
- Sampling on country + data sovereignty
- Logistics of coordinating mass sampling efforts
- Measuring the outcome for citizen scientists

The Great Australian Wildlife Search



The road to “GAWS”

- The Great Australian Wildlife Search (GAWS)
- First iteration: Great Australian Platypus Search (2021)
 - 4070 samples, 1734 unique sites
 - Platypus qPCR
- Transitioned to GAWS from 2022 onwards
 - Biodiversity baselining and surveillance using citizen scientist sampling and a metabarcoding panel



Method



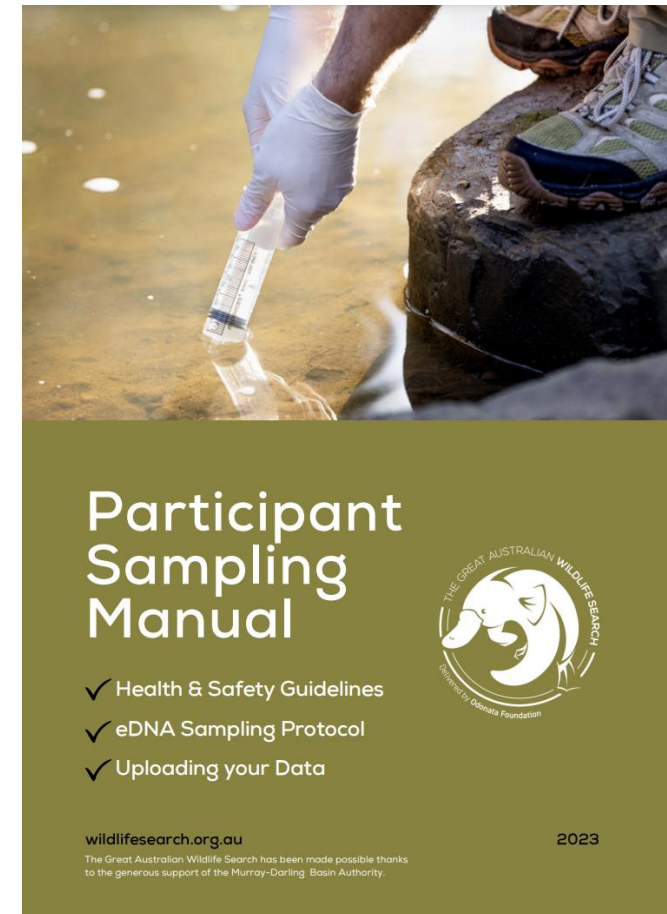
GAWS sample design

- Sampling design identified potential sites
- Sampling undertaken by citizen scientists
 - Citizen scientists recruited through **Odonata communication streams** and **organic sign ups through project website**.
 - **Citizen scientists** signed up and allocated themselves sites to sample from a pool of sites
 - 324 sites within the Murray-Darling Basin were sampled



Resources for Citizen Scientists

- Context and eDNA explainer on website
- **The sampling kits**
 - Consumables for sampling
 - How-to guide (and Youtube link)
 - Safety instructions



Out of the Murray-Darling Basin – Into the lab



- Samples had a limited time to reach the lab for processing – citizen scientists had to act quickly!
- Pipeline designed for eDNA extraction and analysis
- Challenges of working with citizen scientists become apparent here..

Metabarcoding

- 648 samples went through a metabarcoding panel
- Three amplicons were sequenced:
 - 2 fish amplicons to validate findings and negate biases that may occur
 - 1 vertebrate for more general biodiversity data



Fish 16S

- 10,0512 sequences in reference database

Fish 12S

- 19,697 sequences in reference database

Vertebrate

- 36,618 sequences in reference database

Results – 2023 GAWS Round

2024 is currently being sequenced
by Illumina – watch this space!

Results Snapshot

5,905 detections

17 threatened species

26 invasive species



41 **fish** species detected, with 30 native fish, 11 invasive fish and 6 EPBC listed threatened species



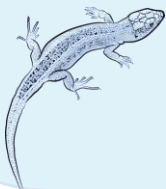
20 **amphibian** species detected, all of which were native to the MDB. We did not detect any EPBC listed species.



43 **bird** species detected, with 40 native species and 3 introduced species.



32 **mammal** species detected, with 20 native species, 12 invasive species and 4 EPBC listed species.



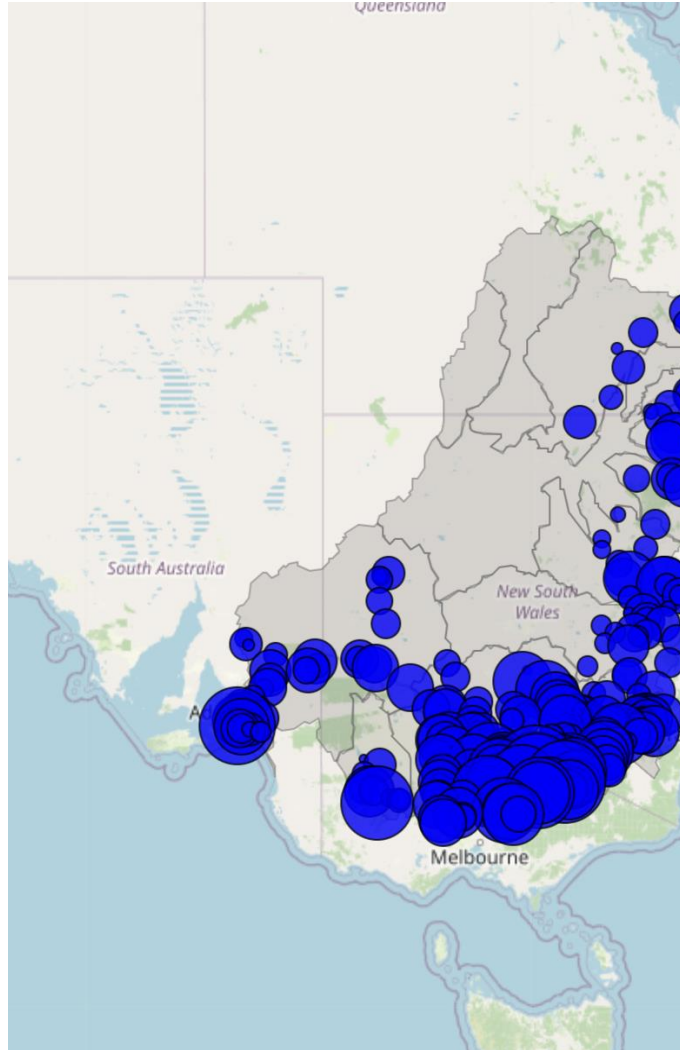
Only 8 **reptile** species were detected.

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Principle 2. Citizen science projects have a genuine science outcome.

Data Explore



Taxon	1	2
Actinopteri		
<i>Cyprinus carpio</i> (European carp)	69742	61592
<i>Gadopsis marmoratus</i> (River blackfish)	49381	24383
<i>Galaxias olidus</i> (Mountain galaxias complex)	3290	944
<i>Maccullochella peelii</i> (Murray cod)	32703	21635
<i>Macquaria ambigua</i> (Golden perch)	804	184
<i>Melanotaenia fluviatilis</i> (Murray-Darling rainbowfish)	715	
<i>Retropinna semoni</i> (Australian smelt)	84798	59362
<i>Tandanus tandanus</i> (Freshwater catfish)	2720	1166
Genus: <i>Hypseleotris</i> (Carp gudgeons)	14453	9054
Amphibia		
<i>Crinia signifera</i> (Common eastern froglet)	114	
<i>Limnodynastes dumerilii</i> (Eastern banjo frog)	376	
<i>Litoria lesueurii</i> (Lesueur's frog)	1908	1027
<i>Litoria peronii</i> (Peron's tree frog)	98	88
Genus: <i>Litoria</i>	6433	1447
Aves		
<i>Chenonetta jubata</i> (Australian wood duckmaned goose)	1281	238
<i>Eolophus roseicapilla</i> (Galah)		189
<i>Fulica atra</i> (Eurasian coot)		64
<i>Gallinula tenebrosa</i> (Common moorhen)	78	31
<i>Microcarbo melanoleucos</i> (Little cormorant)	39	
Family: <i>Anatidae</i>	1054	1729
Genus: <i>Anas</i>	74	272
Genus: <i>Corvus</i>	369	
Genus: <i>Turdus</i>		89
Mammalia		
<i>Bos taurus</i> (Cow)	637	256
<i>Ornithorhynchus anatinus</i> (Platypus)	190	109
<i>Rattus rattus</i> (Black rat)	140	
<i>Trichosurus vulpecula</i> (Common brushtail possum)	46	190
Genus: <i>Trichosurus</i>	463	959
Reptilia		
<i>Emydura macquarii</i> (Macquarie River Turtle)		45
Genus: <i>Chelodina</i>		211

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https://envirodna.shinyapps.io/GAWS_app/

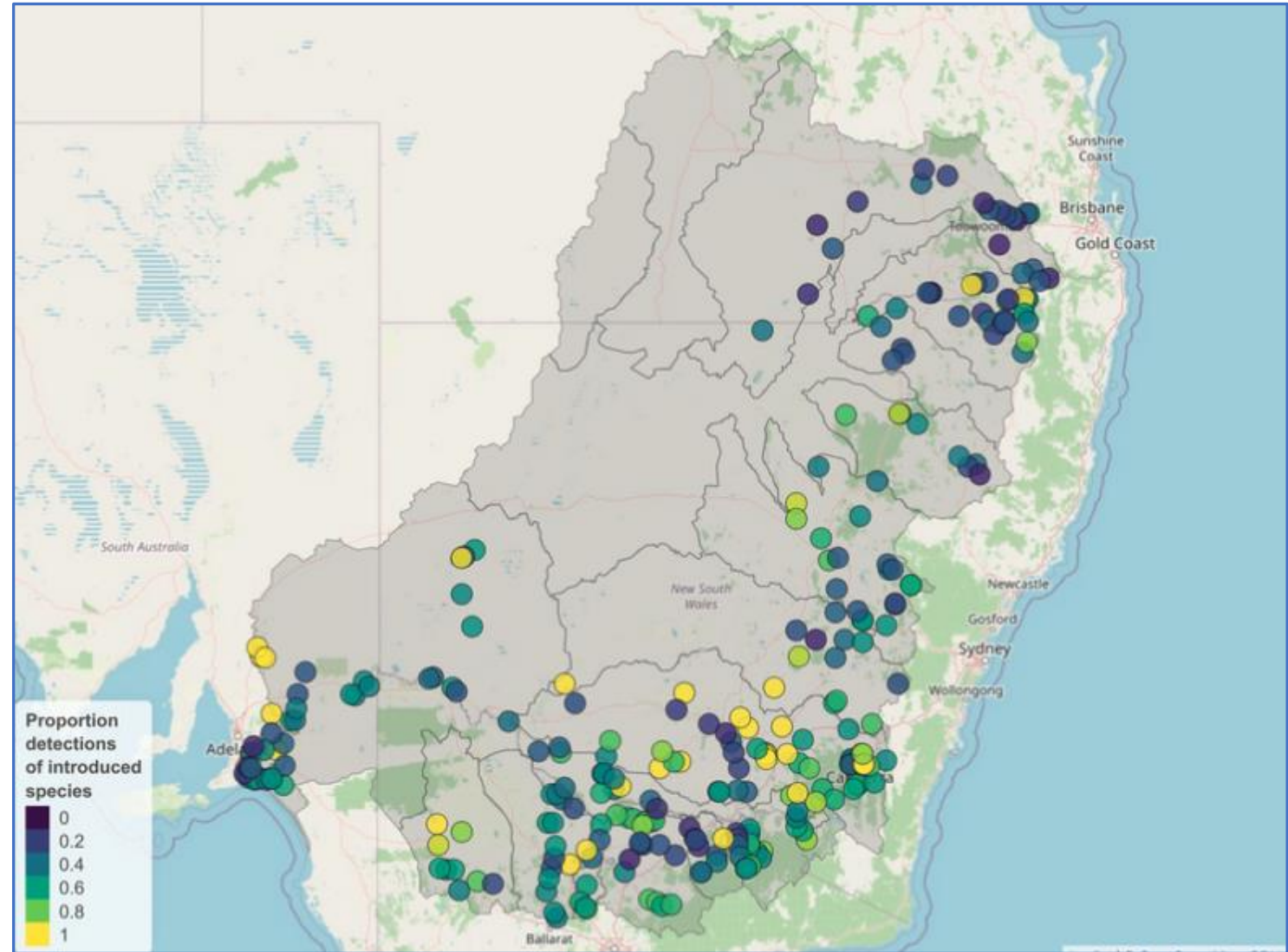


Principle 7. Where possible and suitable, project data and meta-data from citizen science projects are made publicly available and results are published in an open access format.

Invasive fish

- 11 invasive fish species detected
- Gambusia, goldfish, carp, and trout most abundant
- Oriental weatherloach and common roach found in waterways not previously detected in
- No tilapia detections!

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For the Citizen Scientists + General Public..

- 9 page Biodiversity Findings Report
- Uses accessible language
- Highlights major findings
- Includes a FAQ section



Principle 8. Citizen scientists are suitably acknowledged by projects.

Principle 5. Citizen scientists receive feedback from the project.

Future of GAWS

- GAWS provides baseline real time biodiversity data.
- Vision for GAWS to expand across more of Australia, and more dense sampling.
- Sites can be revisited for monitoring – what impact is human activity having on biodiversity? Are our conservation efforts improving species richness or decreasing presence of invasive species?
- 2024 season is at Illumina sequencing as we speak!



Future of Citizen Science

- Citizen Science – as both a science, and a practice – can improve the general public's scientific literacy and enthusiasm for science
- We need to better understand **who** our current citizen scientists are – and who we aren't reaching

"Where I live is environmentally diverse and with the state of the world, struggling with climate change, I wanted to contribute to meaningful research to support my local environment. It was great to see positive eDNA samples in the local waterways especially in small riverways that didn't look that habitable but are an animal's home."

– GAWS participant in 2024 sampling season.

Principle 3. Citizen science provides benefits to both science and society.

Acknowledgments

The Great Australian Wildlife Search is a collaborative effort between the Odonata Foundation, EnviroDNA, and the Murray-Darling Basin Authority. Using pioneering DNA detection techniques, this partnership aims to establish a baseline for the health of aquatic species throughout Australia. With support of the Basin Condition Monitoring Program – an Australian Government commitment to develop and deliver new monitoring and reporting of economic, social, cultural and environmental conditions in the Basin.



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