Australia's National
Science Agency

Public perceptions of using synthetic biology to manage invasive pests

Synthetic biology technologies, such as gene editing, could help manage populations of invasive pest species

Synthetic biology at CSIRO

Synthetic biology is an emerging field of research that combines genetics, chemistry and engineering. Scientists working in synthetic biology design, build, and test DNA to enable plants, animals and other organisms (e.g. bacteria, fungi, algae) to function in different ways. These organisms could then be used to help in the management of environmental and societal problems such as pollution, waste, land degradation and biodiversity loss.

The CSIRO Synthetic Biology Future Science Platform has developed a range of synthetic biology techniques, such as genetic engineering, gene editing and gene marking. But what do Australians think about these techniques? Involving the public is a critical step in the development of any new technology. By understanding Australians' needs, researchers can develop technology that is both fit-for-purpose and impactful for the community.

This brochure is part of a series that explores people's views towards several synthetic biology tools to help solve environmental, industrial and health challenges facing Australia. The full brochure series can be viewed at: **www.csiro.au/synbiosurvey**

We surveyed the Australian public, asking for their initial impressions on using synthetic biology to manage invasive animal species:

- What do people **think and feel** about this new technology?
- What **risks** do they perceive?
- How would people want to be **engaged** in decision-making in the future?

Assessing a technology's suitability

CSIRO has adopted a three-pronged process to explore the development and application of new technology. These three aspects include (1) problem assessment, (2) technical feasibility and (3) social feasibility.

1. Problem assessment

Identification and conceptualisation of a problem and how it fits within the broader human-environment system.

Example: Why are invasive pest species a concern?

2. Technical feasibility

Assessment of current solutions to the problem and proposed new solutions (strengths, weaknesses, opportunities and threats).

Example: What is being done to manage the problem and how effective are these strategies?

3. Social feasibility

Assessment of user and stakeholder perceptions, and acceptability of a range of solutions.

Example: What do communities think of the proposed solutions and what are their views on how the problem is best managed?

Synthetic biology to manage invasive animal species

Managing invasive animal species is critically important to maintain Australia's natural biodiversity and ecosystems. Many invasive species are non-native animals from outside Australia, introduced into the country by humans. Non-native species can have detrimental impacts on the Australian environment and can be referred to as "pests". Native species can also be considered "pests" if they become dominant outside their typical habitat range.

Invasive animal species can negatively impact native flora and fauna, ecosystem biodiversity, agricultural productivity and human/animal health, by damaging crops, spreading disease and changing the way ecosystems function.

The most common methods for managing invasive animals are biological controls (e.g. species-specific viruses), the use of toxic pesticides or baits, animal trapping and, culling via hunting and electrofishing. Total eradication of invasive species is not usually possible, so these methods are used to suppress and control populations in an effort to reduce their negative impacts.

Recently developed synthetic biology technologies, such as gene editing, can potentially be used to reduce numbers of invasive species, by slowing down or even halting population growth. Gene editing involves changing an organism's genetic code by deleting, replacing or inserting a DNA gene sequence. Synthetic biology has the potential to modify a pest species' genes so that offspring are infertile or limited to a single sex (e.g. male-only offspring) - reducing opportunities to reproduce. Over time, this would naturally reduce the population size of future pest generations and potentially limit the impacts of invasive animals on the Australian environment.

Story board sequence shown to survey participants, before they were asked their thoughts about managing invasive pest species using synthetic biology.

Public attitudes towards using synthetic biology for managing invasive pest species

Awareness of invasive pest species in Australia

Our research found that most Australians (about 89%) were at least moderately aware that invasive pest species are present in Australia. The majority of people (94%) also believe that these species are a moderate to very big problem in Australia.

Initial impressions of gene editing in invasive species

After viewing a storyboard presentation on the use of gene editing to manage invasive pest species, Australians reported being moderately-to-strongly supportive of the development of this technology.

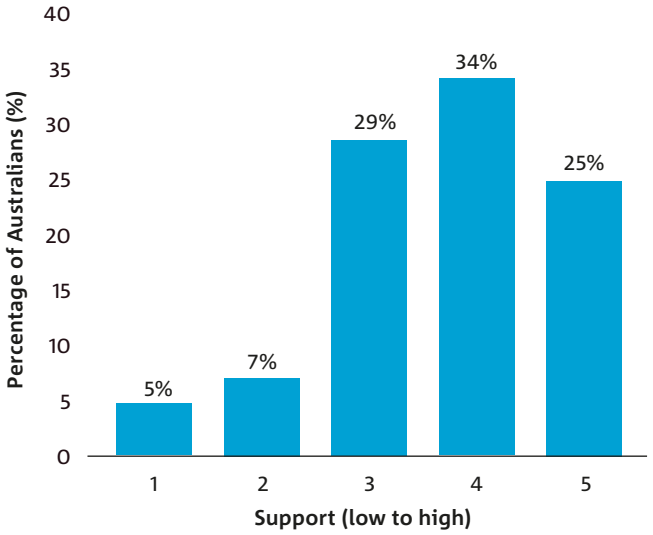


Figure 1 Australians' support of gene editing to manage invasive pest species.

When asked to consider the use of this technology in their local area, more than half (53%) of Australians indicated that they would not be bothered if this technology was implemented in their own community. Approximately 28% indicated being moderately bothered by local implementation and 19% indicated that they were more than moderately bothered. This public concern is important to know and understand, as it helps scientists shape how the technology will be developed.

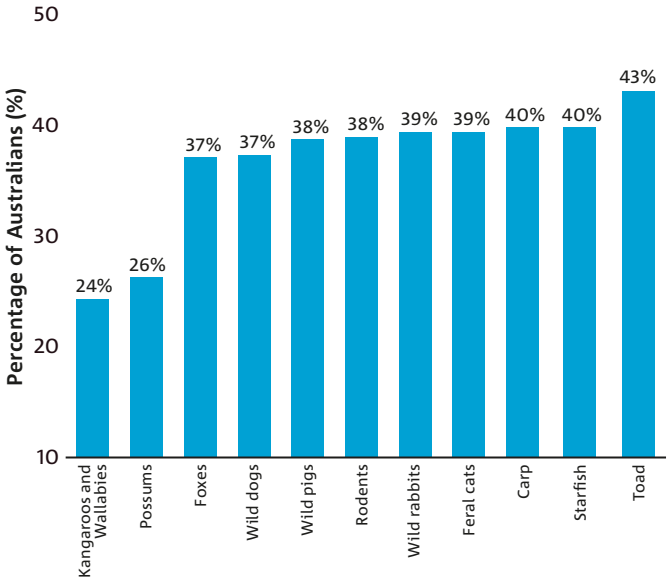
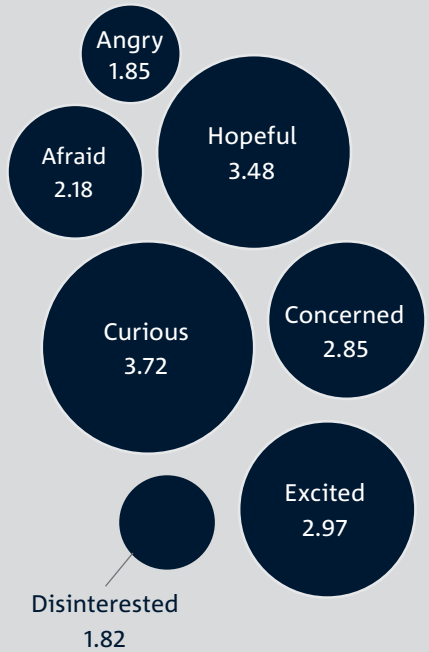


Figure 2 Australians' support for gene editing across pest animal species.

How do Australians feel about synthetic biology?

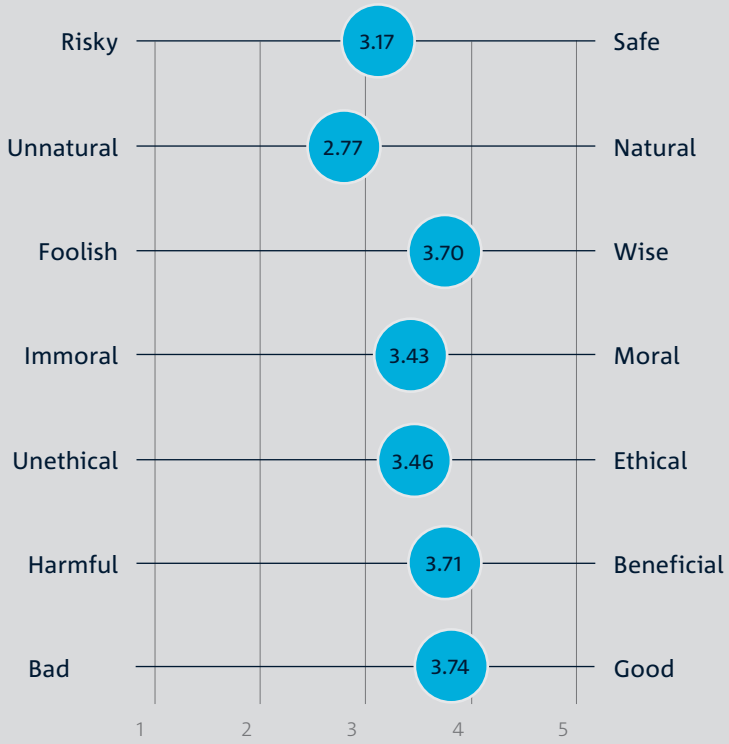
Gene editing to manage invasive pest species

Emotions indicated by Australians*



*Data range: 1 – 5

Attitudinal pairs*



Perceptions of benefits and risks associated with the technology

The majority of Australians (around 93%) rated synthetic biology technologies as moderately to very helpful in managing invasive pest species. Most Australians (65%) agreed or strongly agreed that this technology would be better than current methods of managing pest species.

Despite the support, Australians did have some reservations about the technology. Most were concerned that gene editing could have negative long-term consequences:

- 79% were at least moderately concerned about the consequences for humans and animals
- 76% were at least moderately concerned about the risks to the natural environment
- 84% were at least moderately concerned about whether consequences arising from this technology could be controlled or managed.

Trust and regulation

The majority of Australians (87%) moderately-to-strongly trusted scientists to develop this technology responsibly. However, 78% of people were still concerned about the possibility of the technology being used for 'bad' purposes. Additionally, 84% were concerned that technology misuse could lead to unintended negative consequences.

Most Australians (76%) held moderate trust towards the government agency responsible for approving and regulating the technology. On average, people moderately agreed that legislation and regulation would ensure the technology would be developed in a safe way – 44% agreed strongly that the technology would be well regulated, and 43% also agreed strongly, that legislation and regulation would ensure its safe development.

Public engagement in future

Most Australians (about 82%) indicated they were keen to know more about this type of synthetic biology technology. They said they wanted to know more about:

- the possible risks
- what is being done to regulate and control the technology
- who will benefit and who will bear the risks.

Most Australians (83%) also indicated that the public should have access to an easy-to-read summary of scientific results and 73% agreed that any risk documentation should be made publicly available.

About 42% of Australians thought it was important to consult the public, so their opinions could be considered when making decisions about this technology. Fewer people (38%) thought it was necessary for the public to be kept informed of decisions made about the technology.

Around 18% of Australians indicated that they did not need, or want, to know anything more about this technology than was already provided within the storyboard presented. Our survey also suggests that people may be more interested in understanding the risks and the process of managing these risks, than understanding the benefits of the technology.

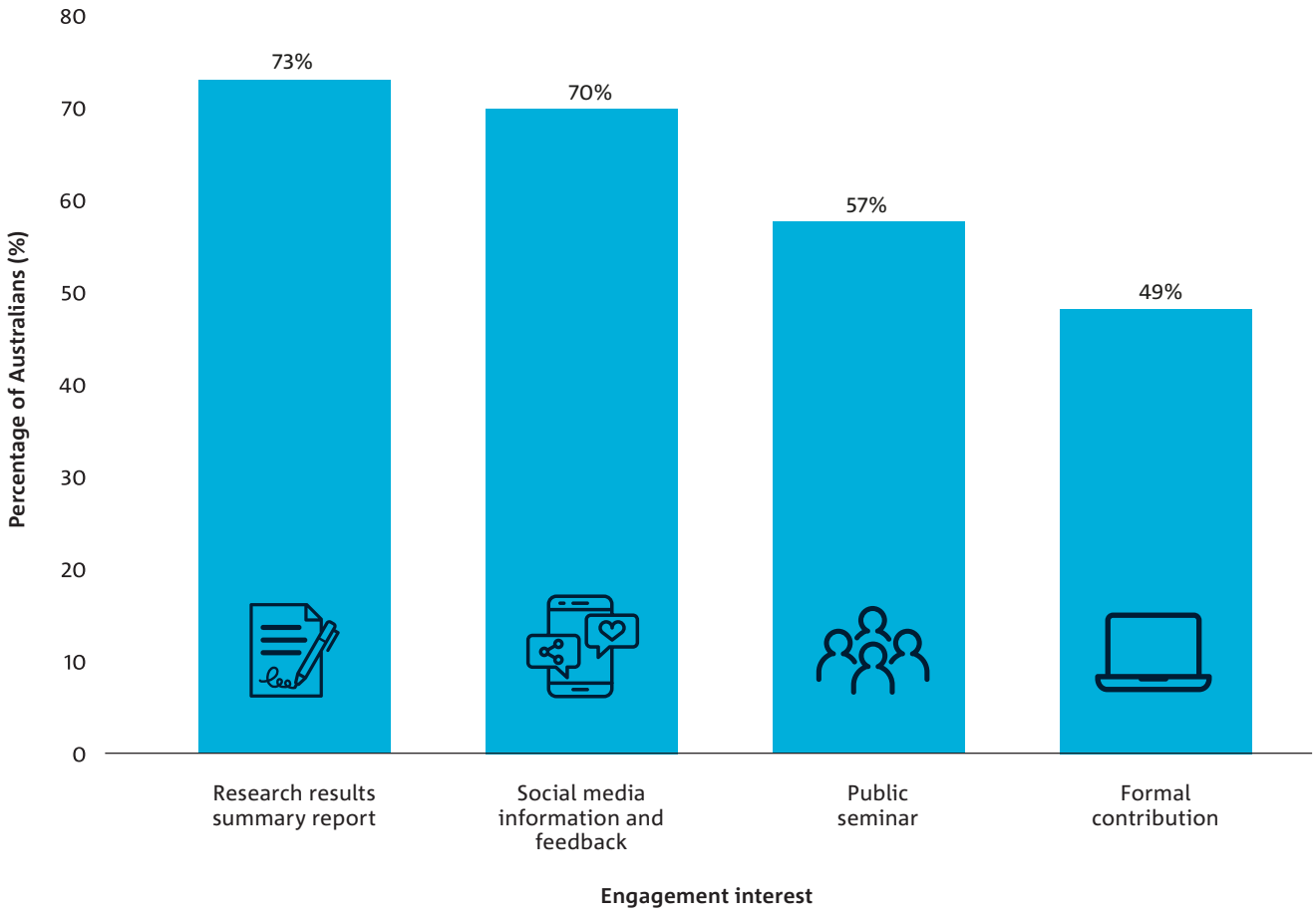


Figure 3 Personal preferences for further engagement with technology development.

Impact

Understanding Australians' attitudes to synthetic biology can help scientists and research organisations to decide how to approach the development and implementation of new technologies.

Our survey findings have many applications and can be used in a variety of ways.

1. By government: to inform policy and regulatory decision-makers on how new technologies will be perceived by the public and how best to engage people.

2. By the science community: to inform scientists on how they can develop and plan future science activities in ways that address users' needs. This approach supports a responsible science agenda and acts as a quality-control measure to ensure that technology is being developed in a worthwhile and meaningful way. The survey findings also build the capacity of scientists to reflect on the social and ethical considerations of their work. Understanding the science and technology needed by Australians to solve current issues can lead to greater and more effective scientific innovation.

3. To benefit society: surveys provide insights into the public's understanding and perceptions of Australian science. Survey data can highlight the extent of society's trust in science and identify knowledge gaps. Increased understanding can shape future science directions and inform better ways for communities and scientists to work together.

This is one of the world's first comprehensive national surveys examining public perceptions across a range of synthetic biology technologies.

Research methods

The study involved presenting an online public opinion survey to a representative sample of 8,037 Australians. It examined how novel synthetic biology technologies could help address a range of important issues facing Australia.

In the survey, we presented information on one of seven environmental, industrial or health challenges in Australia:

- **Managing invasive pest species**
- **Changing the properties of natural fibres**
- **Eliminating the culling of male chicks in the egg-laying industry**
- **Protecting endangered species**
- **Reducing pollution in waterways**
- **Reducing mosquito-borne diseases**
- **Restoring the Great Barrier Reef**

The survey sample was representative of the Australian population in key demographics including age, gender, and location, including representation of Aboriginal and Torres Strait Islander peoples.

The research methodology for this CSIRO study was externally reviewed by a panel of three Australian social and behavioural science experts:

- Professor Kelly Fielding (The University of Queensland)
- Professor Catherine Waldby (Australian National University)
- Professor Iain Walker (Australian National University)

Information was presented to participants in the form of a PowerPoint-style slideshow, known as a 'storyboard'. The storyboards had a standard format with similar sequencing of information, language, use of visuals and length.

Social scientists teamed up with biotechnology scientists and professional science communicators to develop the storyboard content and visuals. The storyboards were validated and tested in seven public focus groups to ensure they were easy to understand and included the necessary information.

The Online Research Unit (ORU) hosted the online surveys throughout October and November 2018 and recruited a representative sample of Australians. Participants received a small standard payment from the ORU for participation. Research participants were randomly assigned to view just one of the seven storyboards.

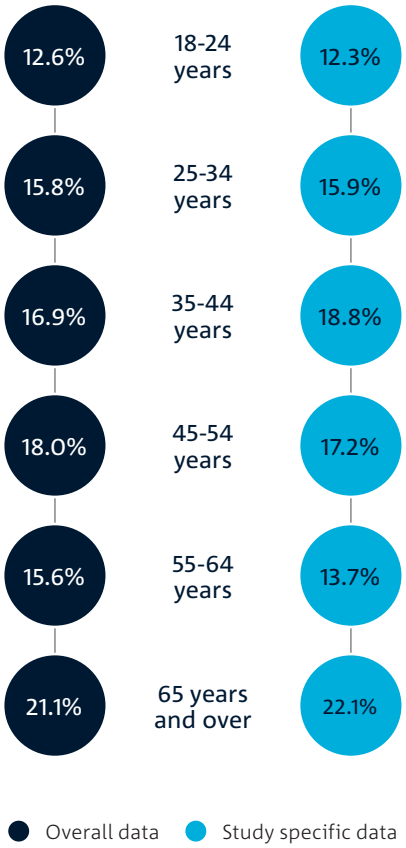
The survey asked participants how they felt about the development of the synthetic biology technology, what concerns they had about the technology, and if they would like to receive more information and be involved in further surveys.

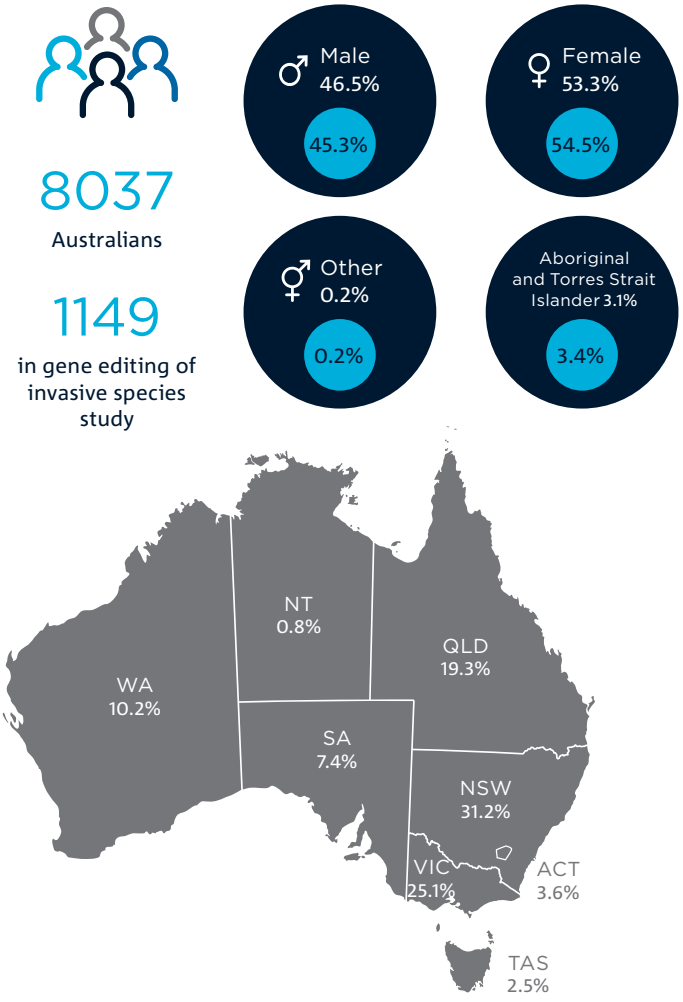
The survey has provided CSIRO with important insights into Australian attitudes. It is a powerful new contribution to decision making in Australia about issues facing the country.

This research was approved by the CSIRO Social and Interdisciplinary Research Human Research Ethics Committee (Ethics Clearance 013/18).

Australian demographic data

All surveys and this specific survey





Next steps in understanding public perceptions of synthetic biology

Our study incorporated a representative sample of the Australian public. However, some topics may be more relevant to particular communities. Future community- or place-based research will therefore be more targeted. It will involve identifying places where a particular synthetic biology technology could help in addressing a problem.

Researchers would engage with local people to understand their views about using new technologies to tackle problems directly affecting them.

This direct engagement will help communities, government and researchers decide whether, and how best, to deliver evidence-based programs to manage invasive species.

As Australia's national science agency and innovation catalyst, CSIRO is solving the greatest challenges through innovative science and technology.

CSIRO. Unlocking a better future for everyone.

Contact us
1300 363 400
csiro.au/contact
csiro.au

For further information
csiro.au/synbiosurvey

Citation

Synthetic Biology Future Science Platform (2020) *Public perceptions of using synthetic biology to manage invasive pests*. CSIRO, Australia.

Copyright

Important disclaimer

B&M | 20-00137