



DEPARTMENT OF PLANNING, INDUSTRY & ENVIRONMENT

Community appreciation of biodiversity indicator

Developing enhanced measures



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1. Introduction

The *Biodiversity Conservation Act 2016* (the BC Act) requires a program for monitoring biodiversity for the State of New South Wales (NSW). To contribute to assessing the performance of the legislation, the former Office of Environment and Heritage NSW established the Biodiversity Indicator Program to report on the status of biodiversity and ecological integrity at regular intervals. Responsibility for implementing this program now rests with the Environment, Energy and Science Group within the Department of Planning, Industry and Environment (DPIE).

The former Office of Environment and Heritage collaborated with the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Macquarie University and the Australian Museum to develop indicators for biodiversity at regional and statewide scales. The overarching monitoring framework, or method, which outlines how indicators are related and derived is presented in *Measuring Biodiversity and Ecological Integrity in New South Wales: Method for the Biodiversity Indicator Program* (OEH & CSIRO 2018).

The method for the Biodiversity Indicator Program established a nested design within which all indicators, as they are developed, have a place. Each indicator is nested with others of its type in an indicator family, and each family is nested within one of five themes which are associated with either the biodiversity or ecological integrity class of indicators. Some indicators may have multiple dimensions to fully characterise how they are measured and reported.

The **community appreciation of biodiversity** indicator sits within the nested framework as follows:

Class:	Ecological integrity
Theme:	4. Ecosystem management
Indicator family:	4.1 Management responses
Indicator:	4.1c Community appreciation of biodiversity <i>The level of community understanding of and support for biodiversity conservation</i>
Readiness category:	3

A technical report, *Assessment of an Indicator of Community Appreciation of Biodiversity* (Fielding et al. 2020), describes the first assessment of the **community appreciation of biodiversity** indicator.

The Biodiversity Indicator Program method described the purpose of the indicator as measuring 'The level of community understanding of, and support for, biodiversity conservation' (OEH & CSIRO 2018, p.45). This indicator was assigned a readiness category of 3, meaning that 'the need has been identified, but the methods, science and data need to be assessed, requiring research, development and testing' (OEH & CSIRO 2018: p.22). All indicators need to be data-driven and evidence-based, scientifically rigorous, sensitive to changes remeasured over five years, and generated using repeatable workflows.

This report follows on from the technical report (Fielding et al. 2020). The technical report described the conceptualisation of an indicator of community appreciation of biodiversity, and used data from the 2015 'Who cares about the environment?' survey (OEH 2017) to provide a first assessment of the indicator (i.e. at the commencement of the BC Act). Because the questions in the 'Who cares about the environment?' survey were not specifically designed to assess the community appreciation of biodiversity indicator, further

development was deemed necessary to generate a pool of questions that could more comprehensively measure the indicator in future surveys. This report describes the process and the outcome of developing the enhanced measurement of the indicator.

As part of developing the enhanced indicator measures we sought further conceptual clarification of each of the indicator dimensions, that is, the cognitive, affective and behavioural dimensions of community appreciation of biodiversity. We drew on relevant theoretical and empirical literature in deepening the conceptual definitions and identifying appropriate measures. The process also involved meetings with representatives from Department of Planning, Industry and Environment, NSW Biodiversity Conservation Trust, and the Australian Museum who provided feedback on the enhanced conceptualisations and proposed measures. In the sections below we discuss each of the indicator dimensions, list the questions that were used to measure the indicator dimensions in the first assessment, and provide suggestions for additional questions/items that could more comprehensively measure each of the dimensions. The report finishes by presenting a set of questions that can more comprehensively measure community appreciation of biodiversity ranked according to priority and survey purpose.

2. Enhanced conceptualisation and measurement of indicator dimensions

2.1 Cognitive appreciation of biodiversity

In the technical report, cognitive appreciation of biodiversity was conceptualised as reflecting the level of knowledge and awareness that people have about biodiversity and biodiversity-related issues. We deepened this conceptualisation by drawing on a paper by Kaiser and Fuhrer (2003) that argues for the importance of different forms of ecological knowledge in underpinning ecological behaviour. Kaiser and Fuhrer propose three key forms of ecological knowledge:

- **Declarative knowledge** relates to an understanding of how environmental systems work. For example, in relation to biodiversity, this would be reflected by an understanding of the benefits of biodiversity and consequences of the loss of biodiversity.
- **Procedural knowledge** refers to an understanding of the types of actions that allow an environmental goal to be achieved. In other words, this is 'how to' knowledge. For example, understanding what types of policies or actions could help to prevent biodiversity loss reflects procedural knowledge about biodiversity.
- **Effectiveness knowledge** refers to knowledge and understanding of the effectiveness of different behavioural options. In the case of biodiversity, this could refer to an awareness of whether certain actions (e.g. recycling versus formally protecting areas) are more or less likely to bring about the desired outcome (e.g. protecting biodiversity).

Note that Kaiser and Fuhrer (2003) also propose social knowledge as another form of ecological knowledge (e.g. knowledge of the behaviour of others regarding biodiversity conservation). As this latter type of ecological knowledge overlaps with the concept of social norms, we limit our indicator development to the more direct forms of ecological knowledge noted above.

2.1.1 Declarative knowledge of biodiversity

One issue that conceptualising declarative knowledge raises is the aspects of biodiversity that are important for people to understand. On the basis of discussions with experts from NSW Government agencies we reasoned that it is important for people to:

1. recognise and understand what biodiversity is
2. recognise the interdependence of living things (i.e. interconnectedness)
3. have knowledge about the threats and pressures to biodiversity
4. have knowledge about the benefits of biodiversity to people and the consequences of its loss.

The five questions drawn from the ‘Who cares about the environment?’ survey that assessed cognitive appreciation in the first assessment all measure declarative knowledge, with:

- one question assessing understanding of the meaning of biodiversity
- two addressing knowledge of threats
- two addressing benefits to people (see Table 1).

Note that Question 1 only really assesses the recognition aspect and not a deeper understanding of what biodiversity is. In the ‘Who cares about the environment?’ survey (OEH 2017) this was overcome by asking a proportion of respondents who said they had heard of the term and know what it means to write down their understanding and these open-ended responses were coded for their accuracy. This approach could also be taken in future research if funds are available for the coding process.

Table 1 First assessment questions from the ‘Who cares about the environment?’ survey used to assess cognitive appreciation of biodiversity

Questions	Response options
1. Are you familiar with the term biodiversity? Would you say....	I’ve heard about it and I know what it means* I’ve heard about it but I’m not sure what it means I’ve never heard about it Don’t know
2. Thinking about PLANTS, as far as you know, would you say...	There ARE native plants species in NSW in serious decline and at risk of becoming extinct* There are NO native plants species in NSW in serious decline and at risk of becoming extinct Not sure/don’t know
3. Thinking about native ANIMALS, as far as you know, would you say...	There ARE native animal species in NSW in serious decline and at risk of becoming extinct* There are NO native animal species in NSW in serious decline and at risk of becoming extinct Not sure/don’t know
4. Nature and biodiversity are essential to the production of food, clean air and water, and medicines for people.	Strongly disagree Disagree Neither agree or disagree Strongly agree* Agree*

Questions	Response options
5. Nature and biodiversity are important for tackling climate change.	Strongly disagree
	Disagree
	Neither agree or disagree
	Agree*
	Strongly agree*
	Not sure/don't know

* Denotes the response that represents cognitive appreciation.

We suggest augmenting these questions to more rigorously test declarative understanding of biodiversity. In particular, questions are needed to address the interconnectedness aspect of biodiversity. The UK Department for Environment Food and Rural Affairs (Christmas et al. 2013) research on engaging people with biodiversity issues assessed people's understanding of the link between biodiversity and the integrity of ecosystems (i.e. interconnectedness), including people's understanding of 'native' versus 'introduced' species. We propose a set of questions drawn from that research in Table 2.

Table 2 Additional questions that could be used to assess declarative knowledge about the interconnectedness aspect of biodiversity and the importance of native species

Questions	Response options
Every species contributes something important to the diversity of life on earth. Problems arise when this diversity is reduced or lost.	Strongly disagree
	Disagree
	Neither disagree or agree
	Agree*
	Strongly agree*
	Don't know
Every species belongs in the places where it is naturally found. Problems can arise when living things are introduced into places where they don't really belong.	Strongly disagree
	Disagree
	Neither disagree or agree
	Agree*
	Strongly agree*
	Don't know

* Denotes an answer that is 'correct' and therefore reflects cognitive appreciation of biodiversity.

We also propose series of questions that assess in more detail people's understanding of threats to biodiversity, as shown in Table 3. Note that this set of questions includes options that can be considered threats to biodiversity and those that are not threats. For this reason we suggest a scoring system where 'incorrect' answers are subtracted from 'correct' answers (based on our current understanding). As an example, if respondents identify that the first four are threats and the last three are not, which is correct, their score would be seven. However, if they provide correct answers to six of the options but incorrectly identify, for example, the hole in the ozone layer as a direct threat to biodiversity, they would get a score of six. The use of negative scoring for incorrect answers had been used in previous measures of ecological literacy (Pitman & Daniels 2016).

Table 3 Additional questions that could be used to assess declarative knowledge about direct threats to biodiversity

Questions	Response options
Which of the following is an important threat to biodiversity in New South Wales?	
Clearing of land	Yes* No Don't know
Pollution (e.g. from plastics and chemicals)	Yes* No Don't know
Invasive (non-native) animals and weeds	Yes* No Don't know
Climate change	Yes* No Don't know
The hole in the ozone layer	Yes No* Don't know
Low rates of household recycling	Yes No* Don't know
People closing down farms	Yes No* Don't know

* Denotes an answer that is correct and therefore reflects cognitive appreciation of biodiversity.

2.1.2 Procedural knowledge of biodiversity

None of the questions from the 'Who cares about the environment?' survey measuring cognitive appreciation addressed procedural knowledge. Drawing from the literature and discussions with experts from NSW Government agencies we identified three facets of procedural knowledge that would ideally be addressed. These included:

1. understanding of specific policies and on-ground actions that facilitate biodiversity protection
2. understanding of the individuals and groups who may be empowered to protect biodiversity
3. knowledge about how to spend time in nature and enjoy it.

Questions relating to these three facets are provided in Tables 4, 5 and 6 respectively.

The third facet recognises discussions at the inception meeting of the Community Appreciation of Biodiversity project that suggested that the indicator should not solely assess knowledge or behaviour aimed at protecting biodiversity, but should also recognise knowledge of how to enjoy biodiversity. We note that the list of individuals and groups responsible for protecting biodiversity in Table 5 could be expanded to include other groups, for example, property developers, resource companies, Aboriginal land councils.

Table 4 Questions that could be used to assess procedural knowledge relating to biodiversity – specifically the policies and actions that could help to protect biodiversity

Questions	Response options
Laws to prevent excessive clearing of trees and plants can help to protect biodiversity.	Strongly disagree Disagree Neither disagree or agree Agree* Strongly agree*
There are certain ways of managing farms that can help to protect biodiversity.	Strongly disagree Disagree Neither disagree or agree Agree* Strongly agree* Don't know
Planting trees in cities is NOT important for biodiversity.	Strongly disagree* Disagree* Neither disagree or agree Agree Strongly agree Don't know
National parks are an important way to protect biodiversity.	Strongly disagree Disagree Neither disagree or agree Agree* Strongly agree* Don't know
It doesn't matter what we do, nature and biodiversity will protect itself.	Strongly disagree* Disagree* Neither disagree or agree Agree Strongly agree Don't know
Laws about threatened species help protect biodiversity on farms.	Strongly disagree Disagree Neither disagree or agree Agree* Strongly agree* Don't know
Fire is needed for some native plant species to regenerate.	Strongly disagree Disagree Neither disagree or agree Agree* Strongly agree* Don't know

* Denotes an answer that is correct and therefore reflects cognitive appreciation of biodiversity.

Table 5 Questions that could be used to assess procedural knowledge related to biodiversity – specifically an understanding of the individuals and groups who could help to protect biodiversity

Questions	Response options
Which of the following groups or individuals could help to protect biodiversity in New South Wales?	
Government	No Yes, a little* Yes, a lot*
Environmental groups	No Yes, a little* Yes, a lot*
Farmers	No Yes, a little* Yes, a lot*
People in NSW towns and cities	No Yes, a little* Yes, a lot*
People like me	No Yes, a little* Yes, a lot*

* Denotes an answer that is correct and therefore reflects cognitive appreciation of biodiversity.

Table 6 Questions that could be used to assess procedural knowledge relating to biodiversity – specifically ways to experience or learn about nature

Questions	Response options
I know a place to go if I want to enjoy nature.	Strongly disagree Disagree Neither disagree or agree Agree* Strongly agree* Don't know
I know a national park to go to if I wanted to.	Strongly disagree Disagree Neither disagree or agree Agree* Strongly agree* Don't know
I know where to go to for information about nature and biodiversity.	Strongly disagree Disagree Neither disagree or agree Agree* Strongly agree* Don't know

* Denotes an answer that is correct and therefore reflects cognitive appreciation of biodiversity.

2.1.3 Effectiveness knowledge of biodiversity

None of the questions from the ‘Who cares about the environment?’ survey assessed efficacy knowledge relating to biodiversity. To some extent the procedural knowledge questions have an element of efficacy knowledge in them. For example, if respondents agree that laws to prevent tree clearing can help to protect biodiversity, they are not only demonstrating that they know *how* to protect biodiversity but also that they agree that this action would be *effective*. We therefore recommend that the questions to measure efficacy knowledge assess the more general concept of whether respondents believe that actions to protect biodiversity can be effective or not. The proposed questions are shown in Table 7. Note that the third question listed in the table focuses on agricultural landscapes, but a similar question could be asked about other contexts (e.g. It’s not worth trying to protect biodiversity when building new housing developments).

Table 7 Questions that could be used to assess efficacy knowledge relating to biodiversity

Questions	Response options
It’s better to prevent biodiversity loss than to try to restore it.	Strongly disagree Disagree Neither disagree or agree Agree* Strongly agree* Don’t know
There’s nothing we can do to slow the loss of biodiversity.	Strongly disagree* Disagree* Neither disagree or agree Agree Strongly agree Don’t know
It’s not worth trying to protect biodiversity in agricultural landscapes. †	Strongly disagree* Disagree* Neither disagree or agree Agree Strongly agree Don’t know

* Denotes an answer that is correct and therefore reflects cognitive appreciation of biodiversity.

† Note that this question could also be asked about urban landscapes.

2.2 Affective appreciation of biodiversity

In the technical report, affective appreciation of biodiversity was conceptualised as positively valuing biodiversity and what biodiversity can provide. One issue this definition raises is that values and valuing are conceptualised differently across disciplines. Rawluk et al. (2019) have reviewed the different conceptualisations of values used in social-ecological research and practice and organise the value concepts on two dimensions:

1. level of abstractness (i.e. concrete objects through to abstract principles)
2. context dependence (i.e. stable generalisable through to dynamic and changing).

At one extreme of the matrix are human values which are highly stable and reflect abstract principles that guide people's lives (e.g. having the goal of social status or prestige and having power over people and resources). At the other extreme are valued entities which represent concrete entities (e.g. a particular place or landscape) that are important to individuals because they have a subjective relationship with them. On the basis of this literature and discussions with experts in NSW Government agencies we adopt this latter conceptualisation of values, that is valued entities, to guide the affective appreciation of biodiversity. That is, to value biodiversity is to consider that it is important because you feel that something is personally important to you. We also note that our conceptualisation of value is different to economics, where value reflects the objective monetary value of an object. The intention with the affective appreciation of biodiversity dimension is not to ascribe a monetary value to biodiversity but instead to assess the subjective perceptions of whether an object is personally important, that is, *valued*.

The five questions from the 'Who cares about the environment?' survey that were used to assess affective appreciation are shown in Table 8. The existing questions primarily assess the *importance* of regional nature and biodiversity to respondents, although one question (Nature & biodiversity are important for my personal recreation, relaxation & spiritual renewal) alludes to the personal importance aspect of valuing. That is, that we may value nature and biodiversity *because* of what we get from it.

Table 8 First assessment questions from the 'Who cares about the environment?' survey used to assess the affective appreciation of biodiversity

Questions	Response options
1. Now a question on protecting natural habitats for native plants and animals in NSW. There are various competing needs for the use of land in NSW. Sometimes decisions need to be made to either protect areas of natural habitat, or, to use the land for other needs. Overall, do you think there is...	Too much emphasis on protecting natural habitats Not enough emphasis on protecting natural habitats* Or, you think the balance is about right in NSW Don't know
2. We have a responsibility to look after nature and biodiversity for future generations.	Strongly disagree Disagree Neither agree nor disagree Agree* Strongly agree*
3. Nature & biodiversity are important for my personal recreation, relaxation & spiritual renewal.	Strongly disagree Disagree Neither agree nor disagree Agree* Strongly agree* Not sure/Don't know
4. Whether I visit these natural places or not, it is important for me to know nature and biodiversity is looked after in NSW.	Strongly disagree Disagree Neither agree nor disagree Agree* Strongly agree* Not sure/Don't know

Questions	Response options
5. To what extent would you say you are concerned about the effect of environmental problems on the following Nature - plants, animals and ecosystems.	A great deal* A fair amount* A little Not at all Don't know

* Denotes the response that represents affective appreciation.

We propose an additional set of questions that drill deeper into the importance and salience of nature and biodiversity through asking respondents how much they worry about the degradation of various habitats and species. These are shown in Table 9. These questions are similar to other questions used in surveys to assess public engagement with biodiversity (e.g. Christmas et al. 2013; Eurobarometer 2013).

Table 9 Additional questions that could be used to assess affective appreciation – specifically importance of the issue

Questions	Response options
How often do you worry about each of the following?	
Decline and disappearance of forests and natural areas.	Never Hardly ever Sometimes Quite often* All the time*
The effect of climate change on nature and biodiversity.	Never Hardly ever Sometimes Quite often* All the time*
Decline and loss of native animal species.	Never Hardly ever Sometimes Quite often* All the time*
Decline and loss of native plants species.	Never Hardly ever Sometimes Quite often* All the time*
Decline and loss of biodiversity in our oceans and waterways.	Never Hardly ever Sometimes Quite often* All the time*

* Denotes the response that represents affective appreciation.

We also propose a set of questions adapted from the ‘Love and care for nature’ scale (Perkins 2010). These questions are shown in Table 10 below. Note that the original scale has 15 items, however, we chose questions that met two main criteria: 1) those that loaded highest on the factor analysis to test the validity of the scale, and 2) those that aligned more closely to the conceptual definition of placing importance on nature and biodiversity because of its personal importance to respondents. To be consistent with the questions used in the original ‘Who cares about the environment?’ survey and other questions proposed for the enhanced indicator, we adapted the 7-point Likert scale to a 5-point Likert scale.

Table 10 Additional questions that could be used to assess affective appreciation – specifically relationship with nature and biodiversity

Questions	Response options
I often feel a sense of awe and wonder when I think about the variety of plant and animal life on earth.	Strongly disagree Disagree Neither disagree or agree Agree* Strongly agree*
I feel that nature and biodiversity are important for my wellbeing.	Strongly disagree Disagree Neither disagree or agree Agree* Strongly agree*
I often feel a strong sense of care towards nature and biodiversity.	Strongly disagree Disagree Neither disagree or agree Agree* Strongly agree*
I feel joy just being in nature.	Strongly disagree Disagree Neither disagree or agree Agree* Strongly agree*

* Denotes the response that represents affective appreciation.

2.3 Behavioural appreciation of biodiversity

In the technical report, behavioural appreciation was conceptualised as actions that fell into one of four categories aligned with a recent typology of pro-environmental behaviours (Larson et al. 2015) that extends previous popular typologies (Stern 2000). These categories included:

- *conservation lifestyle behaviours* that are relatively easy behaviours with a relatively high level of opportunity and frequency (e.g. choosing environmentally friendly household products)
- *land stewardship behaviours* (e.g. tree planting or restoration projects)

- *social environmentalism* which promotes the value of conservation and pro-environmental actions via social interaction or communication
- *environmental citizenship* (e.g. signing petitions).

We also included a question about visiting national parks which does not map onto any of these types of pro-environmental behaviour but was included because it represents, and potentially generates, behavioural appreciation through spending time in nature (Rosa & Collado 2019). The 12 questions used for the first assessment of the behavioural indicator dimension are shown in Table 11 below.

Table 11 First assessment questions from the ‘Who cares about the environment?’ survey used to assess the behavioural appreciation of biodiversity

Questions (Behavioural category)	Response options
1. Use your own bags to carry shopping (Conservation lifestyle behaviour)	Always* Mostly* Sometimes Rarely Never Not applicable/Don't know
2. Choose household products that you think are better for the environment (Conservation lifestyle behaviour)	Always* Mostly* Sometimes Rarely Never Not applicable/Don't know
3. Cleaned up litter in public space, park, or forest (Conservation lifestyle behaviour)	Yes* No Don't know
4. Taken part in Landcare, bushcare, tree planting or other restoration project (Land stewardship behaviours)	Yes/done* No /not done/don't know
5. In the last 12 months rescued wildlife (Land stewardship behaviours)	Yes* No Don't know
6. Tried to encourage someone else to change an activity or practice that you thought was harmful to the environment (Social environmentalism)	Yes/done* No /not done/don't know
7. In the last 12 months collected information on the environment for scientific projects or databases (Social environmentalism)	Yes* No Don't know
8. Tried to find information about an environmental topic or issue (Social environmentalism)	Yes/done* No /not done/don't know

Questions (Behavioural category)	Response options
9. Any other voluntary activity – without getting paid – that benefits the environment (Social environmentalism)	Yes* No Don't know
10. Signed an online petition in support of protecting the environment (Environmental citizenship)	Yes* No Don't know
11. Participated in local development or environmental issues with the aim of protecting/improving the environment (Environmental citizenship)	Yes/done* No /not done/don't know
12. In the last 12 months how many times have you visited a national park? (Other behaviours)	Never 1 to 5 times* 6 to 12 times* More than 12 times* Don't know/can't recall

* Denotes the response that represents behavioural appreciation.

Within the field of biodiversity conservation, much research and practice about conservation behaviours focuses on land stewardship, including private land stewardship. We recognise that these are important. However, when conducting surveys with large community samples, it is important to recognise that most respondents will live in urban settings, and many will have no gardens or yards. To ensure that the majority of respondents are able to answer these questions, we have focused on behaviours that most people can do irrespective of where they live. We have included some land stewardship behaviours as optional. We suggest additional behaviours that fall into the above categories that could be added to future measurement of this indicator dimension as shown in Table 12.

Table 12 Additional behaviours that could be used to assess the behavioural appreciation of biodiversity indicator dimension

Questions	Response options
How often do you do any of the following?	
Conservation lifestyle behaviours	
Make serious effort to significantly reduce your personal carbon footprint	Always* Mostly* Sometimes Rarely Never Not applicable/Don't know
Purchase only Forest Stewardship Council certified wood and paper products	Always* Mostly* Sometimes Rarely Never Not applicable/Don't know

Questions	Response options
Avoid or minimise beef consumption for environmental reasons	Always* Mostly* Sometimes Rarely Never Not applicable/Don't know
Choose fish according to a sustainable seafood guide	Always* Mostly* Sometimes Rarely Never Not applicable/Don't know
Land stewardship behaviours	
Choose insect or bird attracting plants for your private garden, yard or balcony	Yes* No Not applicable/Don't know
Provide artificial habitat for wildlife in your garden or yard (e.g. nest boxes, frog pond, bird bath)	Yes/done* No /not done/don't know
Choose local plants for your private garden or yard, or community projects	Yes* No Don't know
Social environmentalism	
Participated in collecting data or monitoring wildlife or threatened species	Yes* No/don't know
Participated in collecting data or monitoring the health of ecosystems (e.g. waterways, marine environments)	Yes* No/don't know
Shared information on social media about nature or biodiversity †	Yes* No/don't know
Environmental citizenship	
Donated money to an organisation that buys land and protects or restores it	Yes* No Don't know
Donated money to a group that advocates for the environment or protects wildlife	Yes* No/ don't know
Is the environment one of your top three considerations when you vote?	Yes* No/Don't know

Questions	Response options
Other behaviours (that assess time spent viewing/watching nature)	
Watching nature programs or documentaries	Very often* Often* Sometimes Rarely Never Not applicable/Don't know
Spending time observing nature (e.g. bird watching)	Very often* Often* Sometimes Rarely Never Not applicable/Don't know

* Denotes the response that represents behavioural appreciation.

† Note that this question could be adapted so that it was not entirely social media focused, e.g. Share information about nature/biodiversity through social media or other means.

3. Conclusions and final recommendations

In terms of the administration of the Community Appreciation of Biodiversity survey, we make the following recommendations.

- After the first question that asks participants about their understanding of the term biodiversity, provide a clear definition and repeat the definition at critical points (e.g. at the beginning of sections of questions). For example, 'Remember that when we use the term biodiversity, we are referring to....'.
- Questions within blocks should be randomised to avoid 'order effects'. Order effects are when completing one set of questions can influence how someone responds to subsequent questions.

We note that the questions have been constructed in such a way as to reduce biased responding, such as agreeing with all items because they are all positively worded. In some blocks we include some incorrect question options (e.g. the hole in the ozone layer is not an important threat to biodiversity) and some reverse scored questions (e.g. planting trees in cities is NOT important for biodiversity). For the cognitive appreciation dimension that assesses knowledge, we suggest primarily using Likert response options (e.g. Strongly disagree – Strongly agree). The reason for this is to avoid respondents feeling like they are being tested which may induce anxiety or annoyance and lead to them dropping out of the survey. We also note that the questions still need pilot testing to ensure they are clear to the population of interest prior to their use in future surveys.

We note that other questions for each indicator dimension could be asked, however, it is difficult and usually impossible for a survey to measure every aspect of a concept due to the need to reduce respondent fatigue. We also recognise that future surveys may not be able to include all of the questions we have included in this enhanced indicator report. Therefore, we have provided a ranking system for prioritising the inclusion of questions.

- Those ranked with a 1 are essential for inclusion because they are part of the first assessment of the indicator and are therefore needed to allow for comparisons across time.
- Those ranked with a 2 are new questions considered important for a more comprehensive measurement of the indicator dimension.
- Those ranked with a 3 are optional because they may not apply to all respondents (e.g. questions relating to gardens) but might be considered as they add additional information to the measurement of the indicator dimensions.

Tables 13 to 15 below provide the full set of questions/items ranked as above. A column is also included to show how responses to the questions/items should be scored, that is, 1 for a response that indicates cognitive/affective/behavioural appreciation and 0 otherwise. Consistent with the first assessment of the indicator dimensions, each indicator dimension can be computed by summing the questions used to measure the indicator dimension. Note that some questions (i.e. procedural knowledge questions assessing threats) have responses that are considered incorrect and are coded as -1.

Table 13 Cognitive appreciation indicator dimension

Category	Rank	Question	Response option	Coding
Declarative knowledge	1	Are you familiar with the term biodiversity? Would you say....	I've heard about it and I know what it means*	1
			I've heard about it but I'm not sure what it means	0
			I've never heard about it	0
			Don't know	0
	1	Thinking about PLANTS, as far as you know, would you say...	There ARE native plants species in NSW in serious decline and at risk of becoming extinct*	1
			There are NO native plants species in NSW in serious decline and at risk of becoming extinct	0
			Not sure/don't know	0
	1	Thinking about native ANIMALS, as far as you know, would you say...	There ARE native animal species in NSW in serious decline and at risk of becoming extinct*	1
			There are NO native animal species in NSW in serious decline and at risk of becoming extinct	0
			Not sure/don't know	0
	1	Nature and biodiversity are essential to the production of food, clean air and water, and medicines for people.	Strongly disagree	0
			Disagree	0
			Neither agree or disagree	0
			Agree*	1
			Strongly agree*	1
	1	Nature and biodiversity are important for tackling climate change.	Strongly disagree	0
			Disagree	0
			Neither agree or disagree	0
			Agree*	1
			Strongly agree*	1
	2	Every species contributes something important to the diversity of life on earth. Problems arise when this diversity is reduced or lost.	Strongly disagree	0
			Disagree	0
			Neither agree or disagree	0
			Agree*	1
			Strongly agree*	1
	2	Every species belongs in the places where it is naturally found. Problems can arise when living things are introduced into places where they don't really belong.	Strongly disagree	0
			Disagree	0
			Neither agree or disagree	0
			Agree*	1
			Strongly agree*	1
			Not sure/don't know	0

Category	Rank	Question	Response option	Coding
	2	Which of the following is an important threat to biodiversity in New South Wales?		
		Clearing of land	Yes* No Don't know	1 0 0
		Pollution (e.g. from plastics and chemicals)	Yes* No Don't know	1 0 0
		Invasive (non-native) animals and weeds	Yes* No Don't know	1 0 0
		Climate change	Yes* No Don't know	1 0 0
		The hole in the ozone layer	Yes No* Don't know	-1 1 0
		Low rates of household recycling	Yes No* Don't know	-1 1 0
		People closing down farms	Yes No* Don't know	-1 1 0
Procedural knowledge	2	Laws to prevent excessive clearing of trees and plants can help to protect biodiversity.	Strongly disagree Disagree Neither disagree or agree Agree* Strongly agree* Don't know	0 0 0 1 1 0
	2	There are certain ways of managing farms that can help to protect biodiversity.	Strongly disagree Disagree Neither disagree or agree Agree* Strongly agree* Don't know	0 0 0 1 1 0
	2	Planting trees in cities is NOT important for biodiversity.	Strongly disagree* Disagree* Neither disagree or agree Agree Strongly agree Don't know	1 1 0 0 0 0

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Category	Rank	Question	Response option	Coding
	2	National parks are an important way to protect biodiversity.	Strongly disagree	0
			Disagree	0
			Neither disagree or agree	0
			Agree*	1
			Strongly agree*	1
			Don't know	0
	2	It doesn't matter what we do, nature and biodiversity will protect itself.	Strongly disagree*	1
			Disagree*	1
			Neither disagree or agree	0
			Agree	0
			Strongly agree	0
			Don't know	0
	2	Laws about threatened species help protect biodiversity on farms.	Strongly disagree	0
			Disagree	0
			Neither disagree or agree	0
			Agree*	1
			Strongly agree*	1
			Don't know	0
	2	Which of the following groups or individuals could help to protect biodiversity in New South Wales?		
		Government	No	0
			Yes, a little*	1
			Yes, a lot*	1
		Environmental groups	No	0
			Yes, a little*	1
			Yes, a lot*	1
		Farmers	No	0
			Yes, a little*	1
			Yes, a lot*	1
		People in NSW towns and cities	No	0
			Yes, a little*	1
			Yes, a lot*	1
		People like me	No	0
			Yes, a little*	1
			Yes, a lot*	1
	3	Fire is needed for some native plant species to regenerate.	Strongly disagree	0
			Disagree	0
			Neither disagree or agree	0
			Agree*	1
			Strongly agree*	1
			Don't know	0

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Category	Rank	Question	Response option	Coding
Effectiveness knowledge	3	I know a place to go if I want to enjoy nature.	Strongly disagree	0
			Disagree	0
			Neither disagree or agree	0
			Agree*	1
			Strongly Agree*	1
			Don't know	0
	3	I know a national park to go to if I wanted to	Strongly disagree	0
			Disagree	0
			Neither disagree or agree	0
			Agree*	1
			Strongly Agree*	1
			Don't know	0
	3	I know where to go to for information about nature and biodiversity.	Strongly disagree	0
			Disagree	0
			Neither disagree or agree	0
Agree*			1	
Strongly Agree*			1	
Don't know			0	
2	It's better to prevent biodiversity loss than to try to restore it	Strongly disagree	0	
		Disagree	0	
		Neither disagree or agree	0	
		Agree*	1	
		Strongly Agree*	1	
		Don't know	0	
2	There's nothing we can do to slow the loss of biodiversity.	Strongly disagree*	1	
		Disagree*	1	
		Neither disagree or agree	0	
		Agree	0	
		Strongly Agree	0	
		Don't know	0	
2	It's not worth trying to protect biodiversity in agricultural landscapes.	Strongly disagree*	1	
		Disagree*	1	
		Neither disagree or agree	0	
		Agree	0	
		Strongly Agree	0	
		Don't know	0	

* Denotes an answer that is correct and therefore reflects cognitive appreciation of biodiversity.

Table 14 Affective appreciation indicator dimension

Rank	Question/item	Response option	Coding
1	Now a question on protecting natural habitats for native plants and animals in NSW. There are various competing needs for the use of land in NSW. Sometimes decisions need to be made to either protect areas of natural habitat, or, to use the land for other needs. Overall, do you think there is...	Too much emphasis on protecting natural habitats	0
		Not enough emphasis on protecting natural habitats*	1
		Or, you think the balance is about right in NSW	0
		Don't know	0
1	We have a responsibility to look after nature and biodiversity for future generations	Strongly disagree	0
		Disagree	0
		Neither agree nor disagree	0
		Agree*	1
		Strongly agree*	1
1	Nature & biodiversity are important for my personal recreation, relaxation & spiritual renewal	Strongly disagree	0
		Disagree	0
		Neither agree nor disagree	0
		Agree*	1
		Strongly agree*	1
1	Whether I visit these natural places or not, it is important for me to know nature and biodiversity is looked after in NSW	Strongly agree*	1
		Agree*	1
		Neither agree nor disagree	0
		Disagree	0
		Strongly disagree	0
		Not sure/Don't know	0
1	To what extent would you say you are concerned about the effect of environmental problems on the following Nature - plants, animals and ecosystems	A great deal*	1
		A fair amount*	1
		A little	0
		Not at all	0
		Don't know	0
2	How often do you worry about each of the following? Decline and disappearance of forests and natural areas.	Never	0
		Hardly ever	0
		Sometimes	0
		Quite often*	1
		All the time*	1
		The effect of climate change on nature and biodiversity.	Never
	Hardly ever		0
	Sometimes		0
	Quite often*		1
	All the time*		1

Rank	Question/item	Response option	Coding
	Decline and loss of native animal species.	Never	0
		Hardly ever	0
		Sometimes	0
		Quite often*	1
		All the time*	1
	Decline and loss of native plants species.	Never	0
		Hardly ever	0
		Sometimes	0
		Quite often*	1
		All the time*	1
	Decline and loss of biodiversity in our oceans and waterways.	Never	0
		Hardly ever	0
		Sometimes	0
		Quite often*	1
		All the time*	1
2	I often feel a sense of awe and wonder when I think about the variety of plant and animal life on earth.	Strongly disagree	0
		Disagree	0
		Neither disagree or agree	0
		Agree*	1
		Strongly agree*	1
2	I feel that nature and biodiversity are important for my wellbeing.	Strongly disagree	0
		Disagree	0
		Neither disagree or agree	0
		Agree*	1
		Strongly agree*	1
2	I often feel a strong sense of care towards nature and biodiversity.	Strongly disagree	0
		Disagree	0
		Neither disagree or agree	0
		Agree*	1
		Strongly Agree*	1
2	I feel joy just being in nature.	Strongly disagree	0
		Disagree	0
		Neither disagree or agree	0
		Agree*	1
		Strongly agree*	1

* Denotes the response that represents affective appreciation.

Table 15 Behavioural appreciation indicator dimension

Category	Rank	Question	Response option	Code
Conservation lifestyle behaviours	1	Use your own bags to carry shopping	Always*	1
			Mostly*	1
			Sometimes	0
			Rarely	0
			Never	0
			Not applicable/Don't know	0
	1	Choose household products that you think are better for the environment	Always*	1
			Mostly*	1
			Sometimes	0
			Rarely	0
			Never	0
			Not applicable/Don't know	0
	1	Cleaned up litter in public space, park, or forest	Yes*	1
			No	0
			Don't know	0
	2	Purchase only Forest Stewardship Council certified wood and paper products	Always*	1
			Mostly*	1
			Sometimes	0
			Rarely	0
			Never	0
			Not applicable/Don't know	0
	2	Avoid or minimise beef consumption for environmental reasons	Always*	1
			Mostly*	1
			Sometimes	0
			Rarely	0
			Never	0
			Not applicable/Don't know	0
	2	Choose fish according to a sustainable seafood guide	Always*	1
			Mostly*	1
			Sometimes	0
			Rarely	0
			Never	0
			Not applicable/Don't know	0

Category	Rank	Question	Response option	Code
	3	Make serious effort to significantly reduce your personal carbon footprint	Always*	1
			Mostly*	1
			Sometimes	0
			Rarely	0
			Never	0
			Not applicable/Don't know	0
Land stewardship behaviours	1	Taken part in Landcare, bushcare, tree planting or other restoration project	Yes/done*	1
			No /not done/don't know	0
	1	In the last 12 months rescued wildlife	Yes*	1
			No	0
			Don't know	0
	2	Choose insect or bird attracting plants for your private garden, yard or balcony	Yes*	1
			No	0
			Not applicable/Don't know	0
	2	Choose local plants for your private garden, yard or community projects	Yes*	1
			No	0
			Don't know	0
	3	Provide artificial habitat for wildlife in your garden yard (e.g. nest boxes, frog pond, bird bath)	Yes/done*	1
			No /not done/don't know	0
Social environmentalism behaviours	1	Tried to encourage someone else to change an activity or practice that you thought was harmful to the environment	Yes/done*	1
			No /not done/don't know	0
	1	In the last 12 months collected information on the environment for scientific projects or databases	Yes*	1
			No	0
			Don't know	0
	1	Tried to find information about an environmental topic or issue	Yes/done*	1
			No /not done/don't know	0
	1	Any other voluntary activity – without getting paid – that benefits the environment	Yes*	1
			No	0
			Don't know	0
	2	Participated in collecting data or monitoring wildlife or threatened species	Yes*	1
			No/don't know	0
	2	Participated in collecting data or monitoring the health of ecosystems (e.g. waterways, marine environments)	Yes*	1
			No/don't know	0

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Category	Rank	Question	Response option	Code
	2	Shared information on social media about nature or biodiversity	Yes*	1
			No/don't know	0
Environmental citizenship behaviours	1	Signed an online petition in support of protecting the environment	Yes*	1
			No	0
			Don't know	0
	1	Participated in local development or environmental issues with the aim of protecting/improving the environment	Yes/done*	1
			No /not done/don't know	0
	2	Donated money to an organisation that buys land and protects or restores it	Yes*	1
			No	0
			Don't know	0
	2	Donated money to a group that advocates for the environment or protects wildlife	Yes*	1
			No/ don't know	0
	2	Is the environment one of your top three considerations when you vote?	Yes*	1
			No/Don't know	0
Other behaviours	1	In the last 12 months how many times have you visited a national park?	Never	0
			1–5 times*	1
			6–12 times*	1
			More than 12 times*	1
			Don't know/can't recall	0
	3	Watching nature programs or documentaries	Very often*	1
			Often*	1
			Sometimes	0
			Rarely	0
			Never	0
			Not applicable/Don't know	0
	3	Spending time observing nature (e.g. bird watching)	Very often*	1
			Often*	1
			Sometimes	0
			Rarely	0
			Never	0
			Not applicable/Don't know	0

* Denotes the response that represents behavioural appreciation.

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