Supplementary Materials

Testing social acceptance of genetic management in threatened bird conservation: the role of information and framing

Fig. S1. Provided introductory text describing how small threatened populations are under additional pressure from inbreeding and how genetic management can help them to survive – two versions which were randomly provided, a short and a detailed version

Long introduction (background information)

To understand this survey, it is really important that you read the following text.

For a long time, people believed that a 'species' was a group of animals or plants whose members looked similar and could breed successfully with each other, but not with members of other species. Even if members of different species did mate (called 'hybridization'), it was thought that their offspring would be infertile. For example, when horses and donkeys mate, they produce infertile mules.

However, recent research on genes has found that some hybridization between species can produce offspring that can have fertile offspring themselves. Because such hybridization is rare, the species go on looking the same even if they have some genes from a different species.

Within some species there are groups of individuals living in different places that look or sound different from each other but have no trouble hybridizing when they come in contact. These groups are called 'subspecies'.

Today a lot of effort is made to look after both, species and subspecies, because some are becoming very rare and could go extinct.

For both, species and subspecies, hybridization may be considered a threat because hybrids are not quite the same as the animals or plants people set out to conserve.

On the other hand, hybridization can be helpful. When populations are reduced to small numbers, individuals become forced to breed with close relatives. This is called inbreeding. Inbred individuals are more likely to get sick and can have fewer healthy offspring. Hybridization can help species survive by bringing in genes that inbred populations have lost even if the genes come from a different species.

Even where hybridization cannot occur because the offspring are infertile, research is suggesting that new genes with desirable properties can be added to embryos. When the chicks grow, they can be released so the new genes are spread through the wild population.

Inbred populations are different from the original population because they will have lost some genetic variation. In fact, anything we do to conserve a species - such as keeping it safe from predators inside a big fence, breeding it in a zoo or putting a population on an island - favours some genes over others.

The difficulty conservation managers face is to assess how much hybridization is acceptable to society. There is no absolute right or wrong answer about how we try to conserve species or subspecies, and so it is not a decision that scientists should make by themselves. It is a decision that needs to be made by society, and by the politicians and policy-makers who try to represent people's wishes, even if most members of society probably know little about species, subspecies, genes, hybridization or inbreeding.

The purpose of this survey is to get your views about six real life examples among Australian birds. For each, we ask you to assess your level of approval of conservation actions aimed at dealing with inbreeding which are already being undertaken or are being considered.

Short introduction (background information)

To understand this survey, it is really important that you read the following text.

When threatened species populations become very small, close relatives have to breed with each other. This can mean they have fewer offspring and are more likely to get sick. Ways to fix this is to:

- breed them with close relatives that are only a little different (called subspecies),
- breed them with other closely related species, provided the offspring are not infertile (unlike the case when horses and donkeys breed and produce mules, which cannot breed)
- introduce new genes from other species (though this is still a little way in the future).

However, while scientists are able to manage wildlife populations in these ways, policy-makers need to know what the public thinks is acceptable. The purpose of this survey is to get your view based on six real life examples among Australian birds. For each, we ask you to assess your level of approval of conservation actions aimed at dealing with inbreeding which are already being undertaken or are being considered.

Fig. S2. Provided text describing genetic management of six Australian threatened birds with two different framings (short and detailed)

1) **Helmeted honeyeater**

Detailed:
Species: The helmeted honeyeater is a subspecies of the yellow-tufted honeyeater. Yellow-tufted honeyeaters are widespread and common in south-eastern Australia; helmeted honeyeaters occur in one little forested reserve north-east of Melbourne that protects its last patch of habitat. All other suitable habitat was cleared or burnt many years ago.

Population: 50 birds

Current problem with inbreeding: Helmeted honeyeaters used to interbreed with the neighbouring subspecies occasionally until habitat loss isolated the helmeted honeyeaters and prevented mixing. Inbreeding has since been frequent.

Current action: A few birds have been brought in from the neighbouring, slightly smaller, subspecies, the yellow-tufted honeyeater, in the hope of adding genetic variation and so increasing breeding success.

Risk from action: Hybrid birds will be slightly different from the original helmeted honeyeaters.

Risk from no action: Pairs of helmeted honeyeater with the least genetic variation produce fewest young. helmeted honeyeaters are expected to go extinct in the next 50 years because of inbreeding.

Short:
Species: helmeted honeyeaters, a subspecies of the yellow-tufted honeyeater.

Population: 50 birds

Current risk of inbreeding: Inbreeding has been frequent. Inbreeding is reducing the number of young they produce.

Current action: A few birds have been brought in from the neighbouring, slightly smaller, subspecies, the yellow-tufted honeyeater, to increase breeding success.

2) **Eastern bristlebird**

Detailed:
Species: A small population of eastern bristlebirds live in patches of long grassy habitat in north-east New South Wales and in south-east Queensland. A much larger population lives in coastal heath south of Sydney. Some scientists think the ones in the north are a separate subspecies to the ones in the south, others think they are the same. The ones in the north (in north-east New South Wales and in south-east Queensland) are the concern here.

Population: 35 birds

Current problem with inbreeding: The tiny population mostly survives in pairs or small groups that are isolated from each other. Inbreeding is likely to have been frequent and could reduce the number of young they produce.

Current action: Birds from south of Sydney are being brought in to increase the genetic variability of the northern birds.

Risk from action: This will mean fewer differences with the southern population, and there is some chance that anything different about the northern population may be lost by hybridization.

Risk from no action: Inbreeding could drive the northern population extinct in the next 50 years because it cannot produce enough young to persist.

Short:
Species: Northern eastern bristlebirds occur in north-east New South Wales and south-east Queensland. A much larger, slightly different, population of the species occurs south of Sydney.

Population: 35 birds

Current problem with inbreeding: Inbreeding is likely to have been frequent which could reduce the number of young they produce.

Current action: Birds from south of Sydney are being introduced to increase genetic variation of the eastern bristlebirds.

3) **Norfolk Island morepork**

Detailed:
Species: Norfolk Island morepork is a small owl that is widespread in New Zealand but with one subspecies on Norfolk Island, an isolated island 1,400 km east of Australia.

Population: 50 birds

Current problem with inbreeding: In the early 2000s just one female Norfolk Island morepork remained alive. To keep owls on the island, nest boxes were erected and two males of the New Zealand subspecies were brought to the island. The female and one of the males had many offspring but all 50 owls on the island come from the one pair. Recently there has been a drop in breeding success which may be because of inbreeding.

Potential action: Bring in more birds from New Zealand.

Risk from action: Introducing more New Zealand moreporks would mean that Norfolk Island morepork genes would be outnumbered and the owls on the island would be more like the New Zealand subspecies than the original.

Risk from no action: Having no new genes could mean that no owls survive on the island, which, in the next 25 years, could cause the extinction of all Norfolk Island morepork genes.

Short:
Species: Norfolk Island morepork is a small owl that is widespread in New Zealand but with one subspecies on Norfolk Island, an isolated island 1,400 km east of Australia.

Population: 50 birds

Current problem with inbreeding: All birds on the island come from a single female mated with a male New Zealand morepork, and breeding success has recently gone down.

Potential action: Bring in more moreporks from New Zealand.

4) **Western ground parrot**

Detailed:
Species: Western ground parrots occurs in a single park in southern Western Australia. Two other ground parrot subspecies occur in eastern Australia and Tasmania. Western and eastern ground parrots have been separated for an estimated five million years and live in different habitats. There is a debate among scientists

about whether ground parrots are one species or two, with western ground parrots being classified as a distinct species.

Population: fewer than 100 birds

Current problem with inbreeding: The number of individuals of the western sub-species has declined in the last 20 years because of cats and change in patterns of fire caused by humans. Inbreeding is inevitable because the population is so small.

Potential action: Introducing some eastern birds could add to the genetic variability of the birds in the west. They may have more young and have greater resistance to disease than if there is no mixing of the two types.

Risk from action: Because eastern and western ground parrots have been separated for so long, the offspring of one western and one eastern ground parrot could therefore be considered a hybrid between two species, even if it can breed successfully. Or they could be hybrids between two subspecies.

Risk from no action: western ground parrots could go extinct from inbreeding in the next 50 years, though fire and cats are much bigger risks.

Short:
Species: Western ground parrots occur in a single park in southern Western Australia. Other subspecies of ground parrots occur in eastern Australia and are much more common, particularly in Tasmania.

Population: fewer than 100 birds

Current problem with inbreeding: The number of individuals of the western sub-species has declined in the last 20 years because of cats and change in patterns of fire caused by humans. Inbreeding is inevitable because the population is so small.

Potential action: Introducing some eastern birds could add to the genetic variability of the birds in the west. They may have more young and have greater resistance to disease than if there is no mixing of the two types.

5) **Orange-bellied parrot**

Detailed:
Species: Orange-bellied parrots are small parrots that breed in south-western Tasmania and migrate to mainland Australia in winter. A close relative which has always been considered a separate species, the blue-winged parrot, also breeds in Tasmania and migrates north in winter. The orange-bellied parrots are the concern here.

Population: 50 birds

Current problem with inbreeding: Inbreeding has left the parrots with a weak immune system. They are known to be vulnerable to several infectious diseases.

Possible action: Hybridization of a small number of orange-bellied parrots with blue-winged parrots could introduce genes that could improve the immune system of the orange-bellied parrots.

Risk from action: Hybrids between the orange-bellied and blue-winged parrots would not be wholly one species or the other.

Risk of no action: Without hybridizing them, orange-bellied parrots could become even more vulnerable to disease. They could also have fewer and fewer young.

Short:
Species: Orange-bellied parrots are small parrots that breed in south-western Tasmania and migrate to mainland Australia in winter. The blue-winged parrot, a similar but different species, also breeds in Tasmania and migrates north in winter.

Population: 50 birds

Current problem with inbreeding: Inbreeding has left the parrots with a weak immune system which makes them vulnerable to disease.

Possible action: Hybridize orange-bellied with blue-winged parrots to increase their genetic diversity.

6) **Lord Howe woodhen**

Detailed:
Species: Lord Howe woodhens live only on Lord Howe Island, a small mountainous island 800 kms north-east of Sydney. They have no close relatives and cannot fly.

Population: about 500 birds

Current problem with inbreeding: They almost went extinct after pigs were introduced and went wild. However, one mountain, Mount Gower, was too steep for feral pigs to reach the top. There, for perhaps 100 years, a population of no more than 12 persisted when all others on the island were killed. Removal of the pigs and other threats has allowed the woodhens to come down from the mountain, and for the population to increase to more than 500 individuals, but all birds are highly inbred.

Possible action: New technologies are being developed for transferring genes between unrelated species. If inbreeding proves to be a problem in the future, this technology could be applied to woodhens. This could improve their genetic variability. The number of genes that could be introduced would be a few among many tens of thousands and the birds would continue to look and behave like woodhens.

Risk from action: The genetic make-up would be altered by people in new ways with a small number of genes from another species.

Risk from no action: Eventual extinction from inbreeding, though this appears not to be a problem at the moment.

Short:
Species: Lord Howe woodhens live only on Lord Howe Island, a small mountainous island 800 kms north-east of Sydney.

Population: about 500 birds

Current problem with inbreeding: Lord Howe woodhens are highly inbred and could face problems in the future.

Possible action: While they have no close relatives, new technologies could make it possible to introduce genes from other unrelated species.

Fig. S3. Correlations among explanatory variables

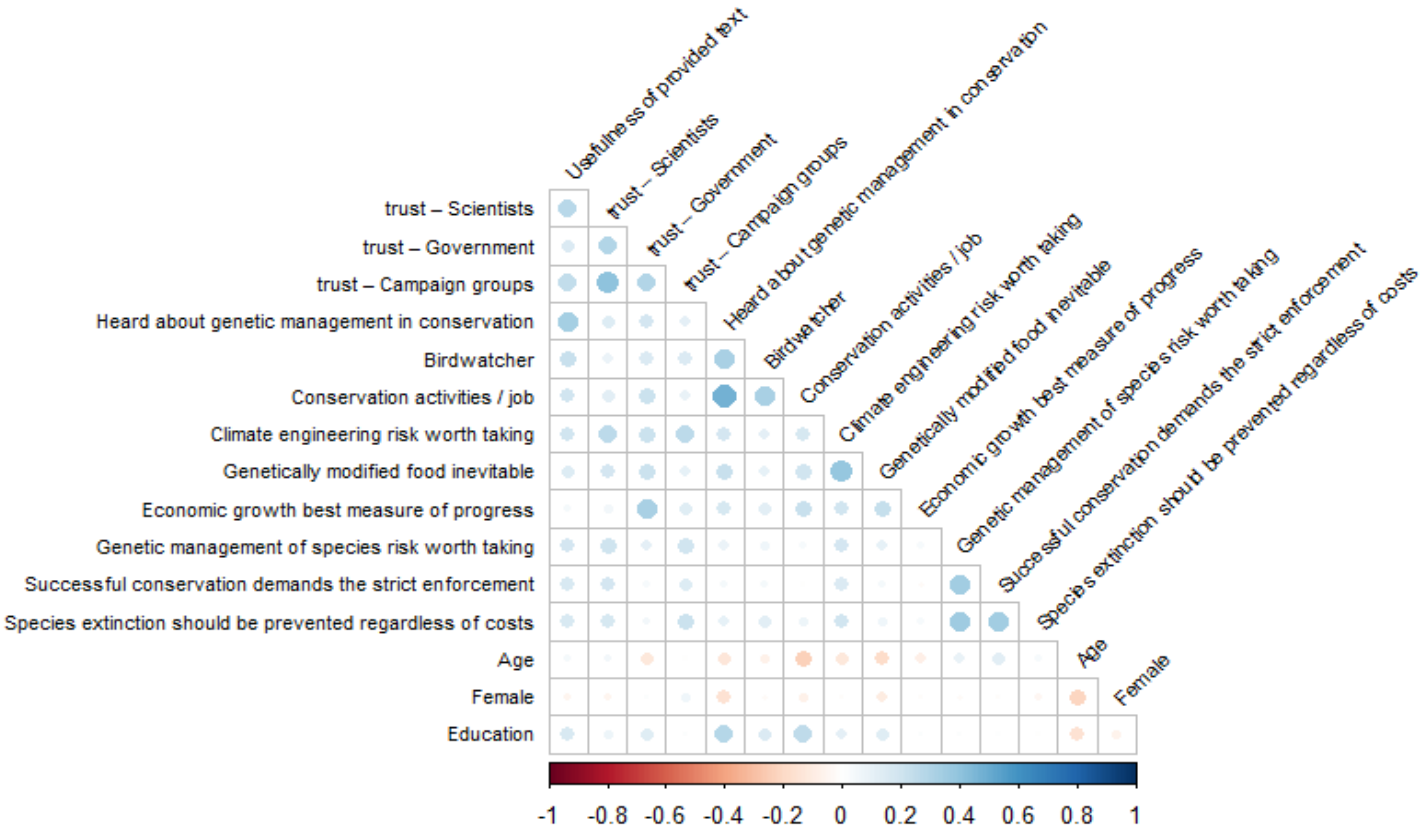


Fig. S4. Demographic profile of sample compared to the national population of Australia (≥18 years of age)

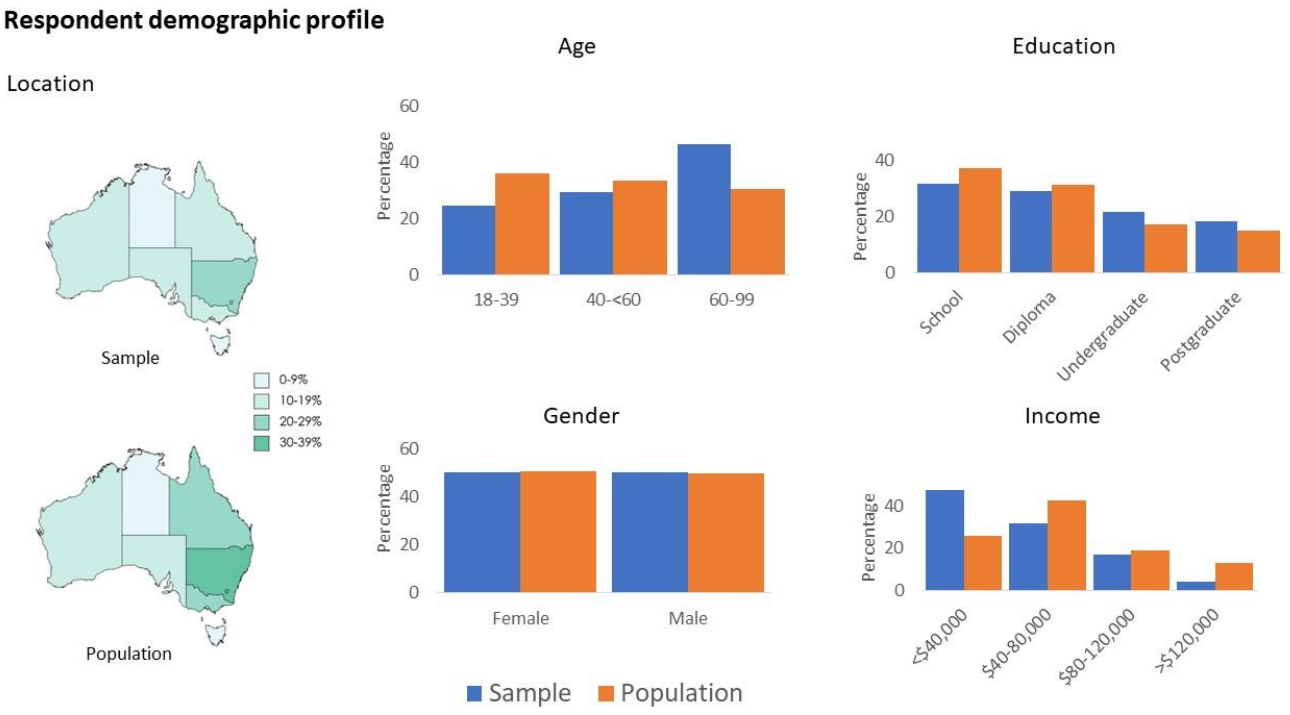
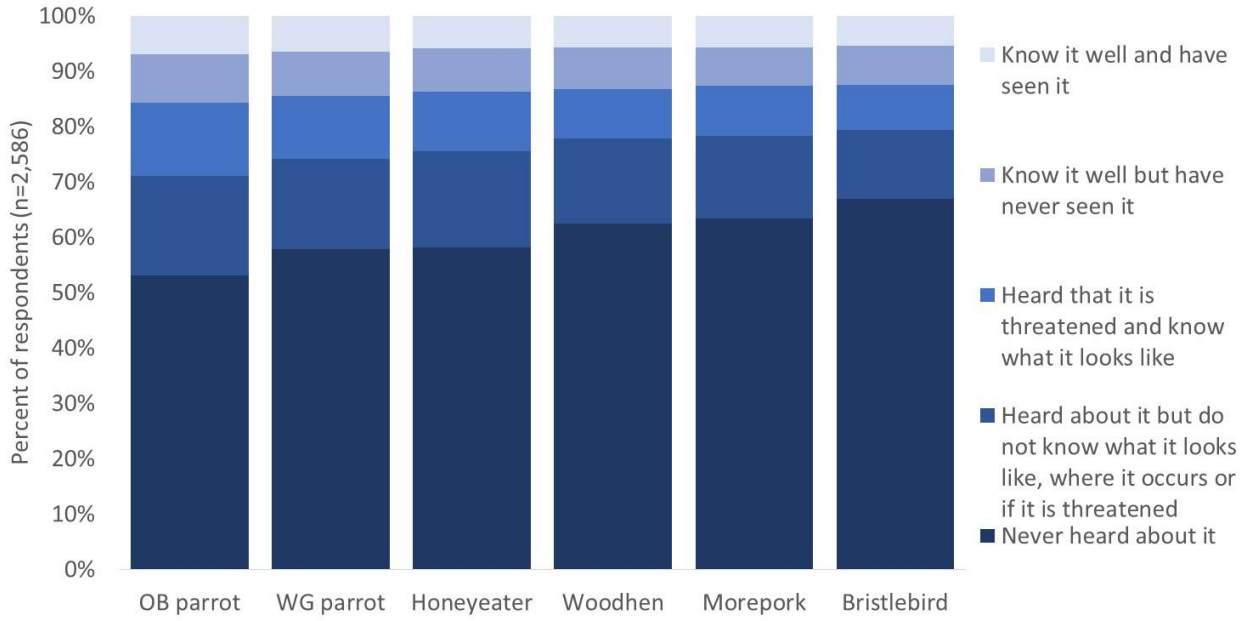


Fig. S5. Respondents' level of knowledge about presented bird species



OB

Parrot = orange-bellied parrot; WG Parrot = Western ground parrot

Fig. S6. Respondents' level of trust in responses of different entities to conservation issues

