

Eradication of pigs on Kangaroo Island: updated predictions to inform the probability of eradication

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Executive summary

Surveys in February 2021 indicated that feral pigs have recolonised watercourses in remote areas, which are not accessible for trapping and baiting.

This report outlines three scenarios to inform the future of the pig eradication program, including two scenarios that require additional investment in thermal-assisted aerial culling.

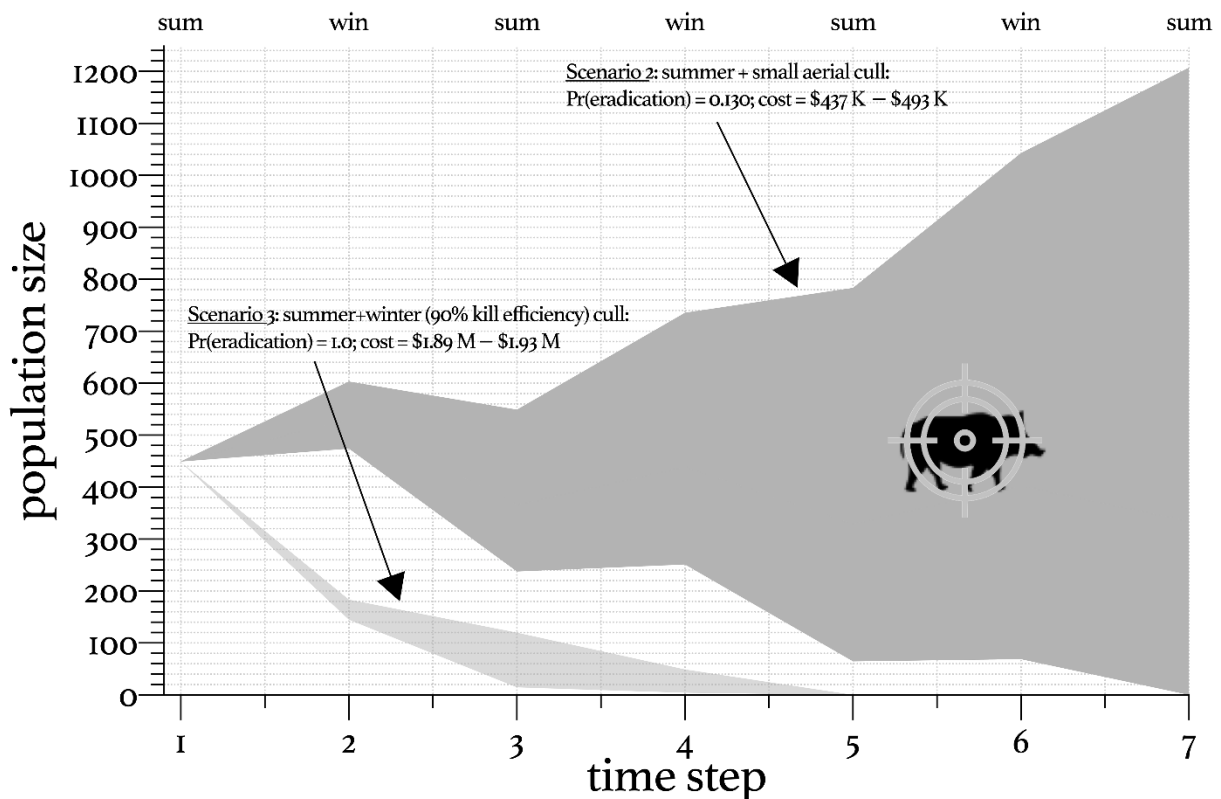
While the native vegetation remains sparse following the 2019–2020 bushfires, thermal-assisted aerial culling is expected to detect 90 per cent of pigs present in areas surveyed, all of which will be culled.

This report updates predictions of pig abundance and distribution under three scenarios: (1) no further culling, which results in population recovery in approximately 20 years, (2) thermal-assisted aerial culling in 21,000 hectares of the high-quality pig habitat once per year for three years, and (3) thermal-assisted aerial culling in 145,000 hectares (total pig-infested area) once per year for three years.

The models decisively indicate that an additional investment of \$1.8 million into thermal-assisted aerial culling would eradicate pigs from Kangaroo Island, including one year of surveys to demonstrate proof of freedom.

Scenario 3 is the preferred option, because it is the only one that is likely to achieve eradication. This scenario predicts eradication with 100 per cent probability after 2 years (as shown in light grey on the graph below, with confidence limits spanning 1.5 to 2.25 years).

The additional cost of thermal-assisted helicopter culling for Scenario 3 is \$1.8 million; with \$600,000 of that used to confirm eradication in the third year (minimal or no culling is predicted to be required in the third year).



Background

Thermal-imaging surveys in February 2021 indicated that pigs have recolonised watercourses in remote parts of the National Parks in western Kangaroo Island. Because these areas are not accessible for trapping and baiting, the pig-eradication program needs to incorporate new methods.

Accordingly, in March 2021, a \$100,000 trial of thermal-assisted aerial culling is planned across habitats that are preferred by pigs. Thermal assisted aerial culling uses military-grade thermal imaging to scan large areas to detect and cull pigs. This method can even detect pigs that are hiding in vegetation.

Thermal-assisted aerial culling has not previously been budgeted, because its efficacy and availability could not be confirmed when the eradication program was proposed.

This report provides revised models of pig abundance and distribution, and explores scenarios to cull them.

Three scenarios to inform the eradication program

When the recent surveys identified that pigs had recolonised remote parts of National Parks on western Kangaroo Island, three scenarios were modelled to inform the future of the program:

Scenario 1: No further culling of pigs on Kangaroo Island as of 1 March 2021

No additional investment in thermal culling and no further trapping or baiting of pigs, because these methods would not eradicate pigs.

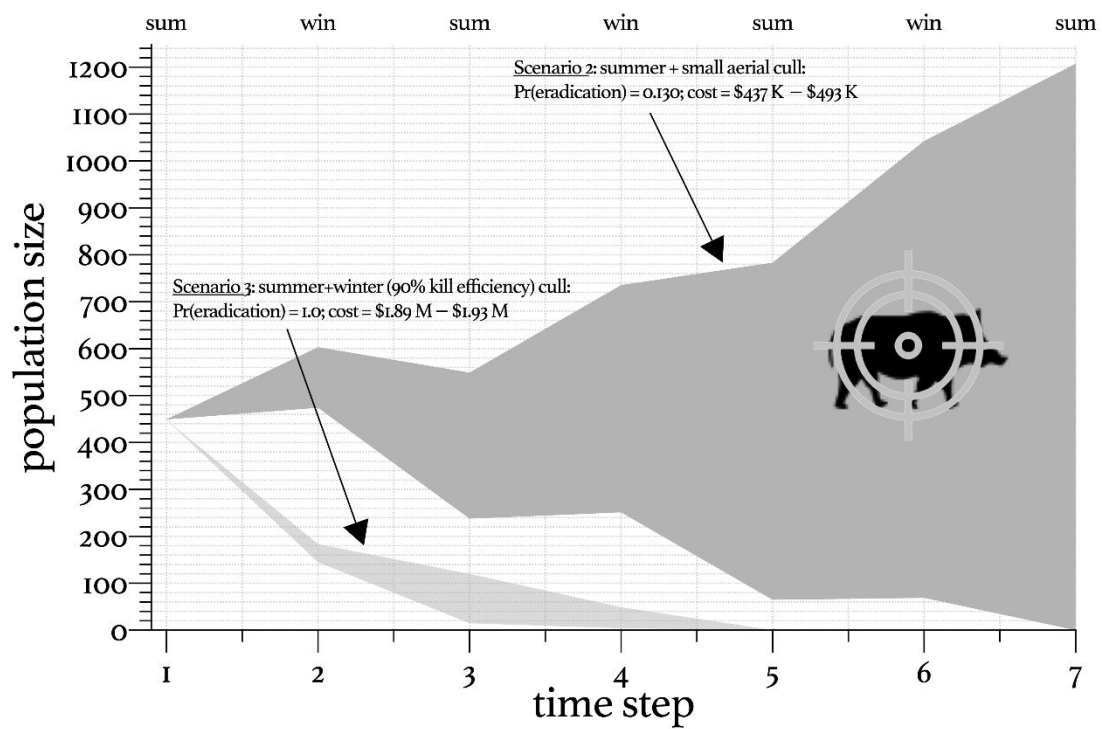
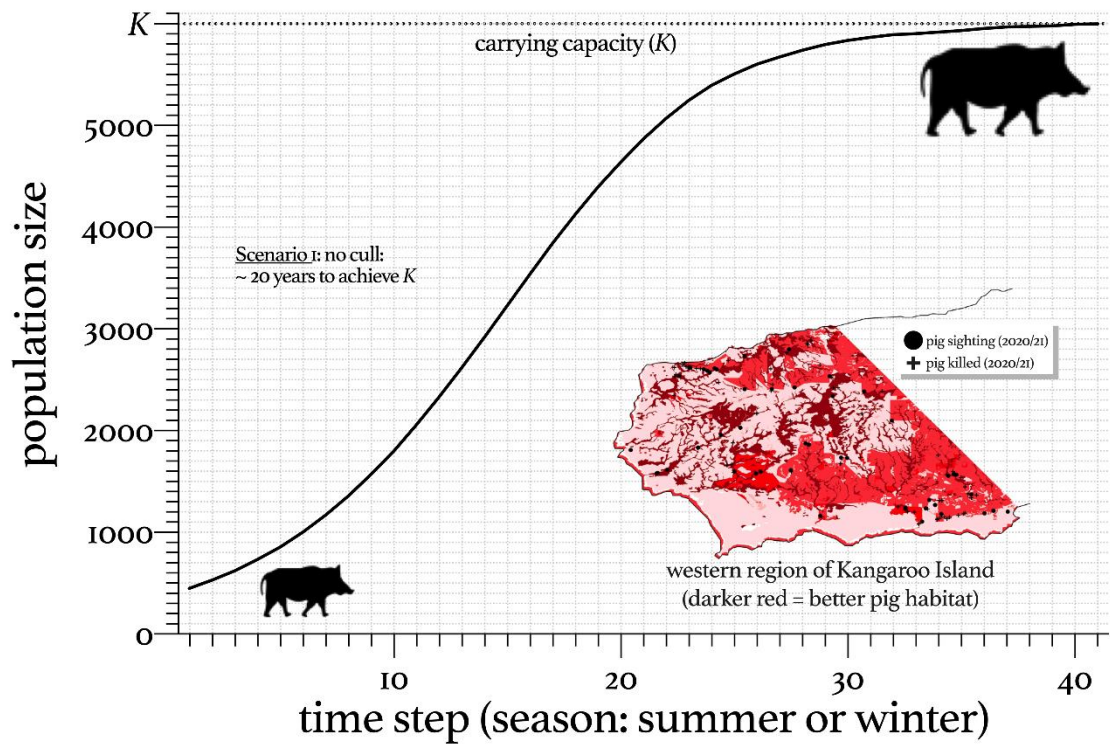
Scenario 2: Continue baiting, trapping and ground shooting, plus 30 hours of thermal-assisted thermal culling in each of the summers of 2021, 2022 and 2023

Continue trapping and baiting plus 30 hours of thermal-assisted aerial culling late in the summers of 2021, 2022 and 2023 to target pigs that are aggregated along permanent water courses.

Scenario 3: All of scenario 2 activities, plus 250 hours of thermal-assisted thermal culling in each of the summers of 2021, 2022 and 2023

Undertake all of scenario 2 activities, plus 250 hours of thermal-assisted thermal culling in each of the winters of 2021, 2022 and 2023 across the entire 145,000 hectares of pig-infested area.

The three scenarios are explained in more detail below, and the following figure summarises the results.



Scenario 1

No further culling of pigs on Kangaroo Island as of 1 March 2021

This scenario is an option if the eradication of pigs is not deemed to be feasible. Under this scenario the remaining 350 to 450 pigs will take approximately 20 years to reach the carrying capacity (6,000 pigs) in the western half of the island. This scenario is depicted by the solid line on the top plot of the above graph.

Note that the x-axes on the above graphs are both “time steps” from the models. Importantly, there are 2 time-steps per year (summer and winter), so the top plot depicts 20 years (40 time steps), and the bottom plot 3.5 years (7 time steps).

Scenario 2

Continue baiting, trapping and ground shooting, plus 30 hours of thermal-assisted thermal culling in each of the summers of 2021, 2022 and 2023

This scenario continues the baiting, trapping and ground-shooting program, which has culled 258 pigs since the bushfire (5 other pigs were culled from a helicopter). These methods are extremely effective in areas that can be accessed by vehicles, but cannot be used in remote parts of National Parks.

This scenario reallocates existing budgets to include 30 hours of thermal-assisted culling across 21,000 hectares of the high-quality pig habitat. These culls would be done once per year in each of the summers of 2021, 2022 and 2023. The areas to be surveyed are the banks of the permanent watercourses, which are highlighted in yellow on the map below, with National Parks outlined in green. This thermal-assisted cull would be expected to kill more than 130 pigs in March 2021, with numbers culled decreasing in subsequent years.

This scenario is depicted by the darker grey shading (confidence limits) on the bottom plot on the above graph. The large, shaded area indicates low confidence in these estimates, which indicate that after 3.5 years the probability of eradication is only 13 per cent. Eradication probability is low because only 15 per cent of the total area used by pigs is covered by thermal-assisted aerial surveys



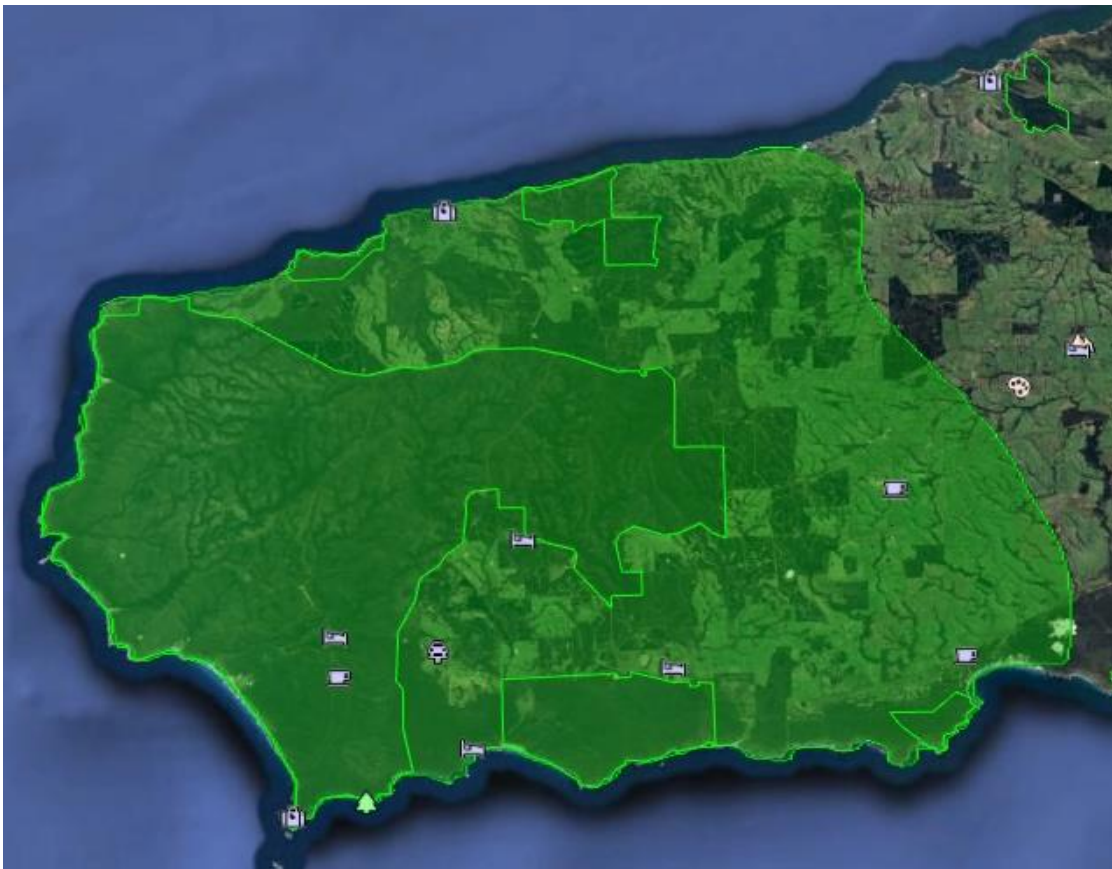
Scenario 3

All of scenario 2 activities, plus 250 hours of thermal-assisted thermal culling in each of the summers of 2021, 2022 and 2023

This scenario includes all of the activities in scenario 2, plus, in winters of 2021, 2022 and 2023, this scenario includes 250 hours of transects (thermal-assisted culling) across the entire area used by pigs. This area is highlighted in green in the map below, with National Parks outlined in green.

The third year of thermal-assisted culling would actually be used to confirm eradication (minimal or no culling is predicted to be required in the third year).

This thermal-assisted culling would be expected to remove all of the pigs in two years. This scenario is depicted by the grey, shaded area on the bottom plot on the above graph. The model indicates that the probability of eradication is 100 per cent after 2 years. The narrow, shaded area indicates a high degree of confidence in this estimate.



Methods: Data used for scenario modelling

Carrying capacity, breeding season and rate of population growth

The carrying capacity of pigs in the western end of Kangaroo Island was estimated to be 6,000 individuals.

On Kangaroo Island, pigs breed year-round, and sows have two litters per year.

The maximum rate of population growth of 0.34 was based on results of pig population studies in Kakadu.

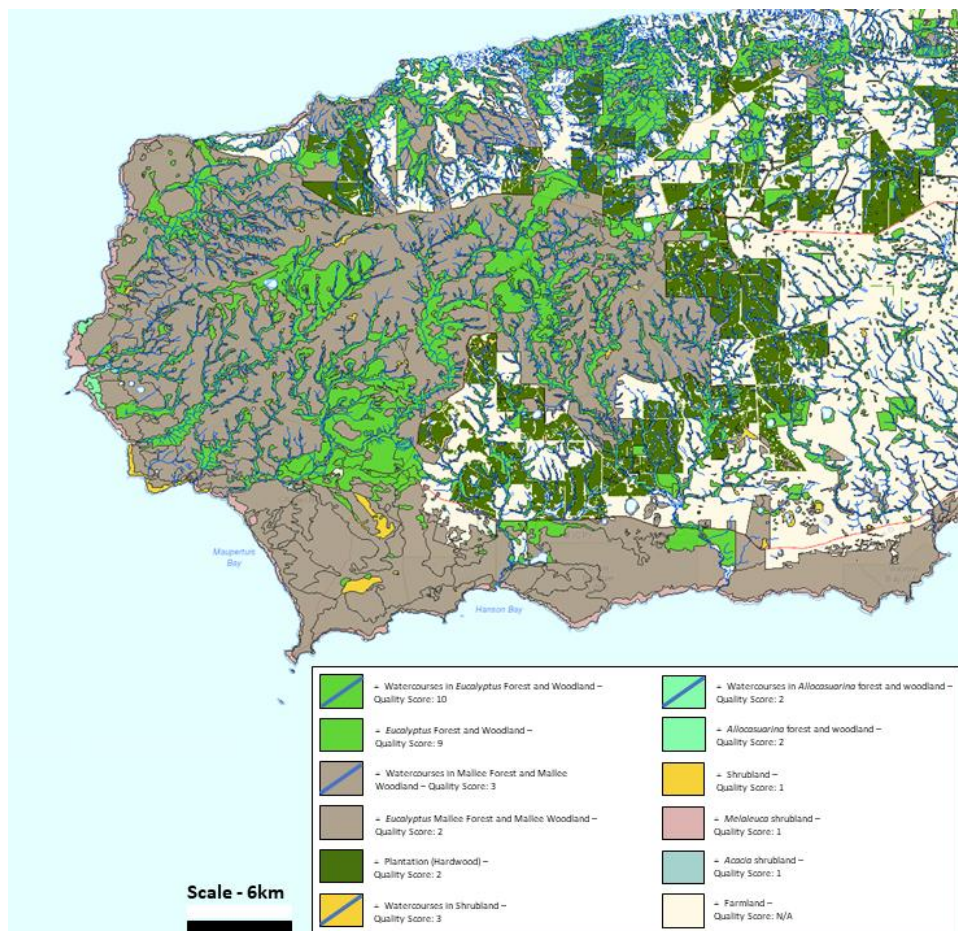
Numbers and densities of pigs on Kangaroo Island

- 5,000 were estimated to be on Kangaroo Island before the bushfire.
- 263 pigs have been culled since the bushfire.
- Between 350 and 450 pigs are estimated to remain on the island as at 1 March 2021. All of the modelled scenarios take a conservative approach, and start with 450 pigs.

On Kangaroo Island, the highest densities of pigs are along permanent rivers in *Eucalyptus* forest and woodlands, particularly during summer. Based on thermal surveys of 13.5 km² of these habitats in February 2021, which were estimated to see 90 per cent of the pigs in the survey area, the estimated density of pigs was 3.3 pigs per km². The density of pigs in this habitat is estimated to decrease by 20 per cent over winter, to 2.6 pigs per km², when additional surface water means pigs can disperse to other habitats.

Pigs do not use the lower-quality habitats in summer, but densities increase in these habitats in winter.

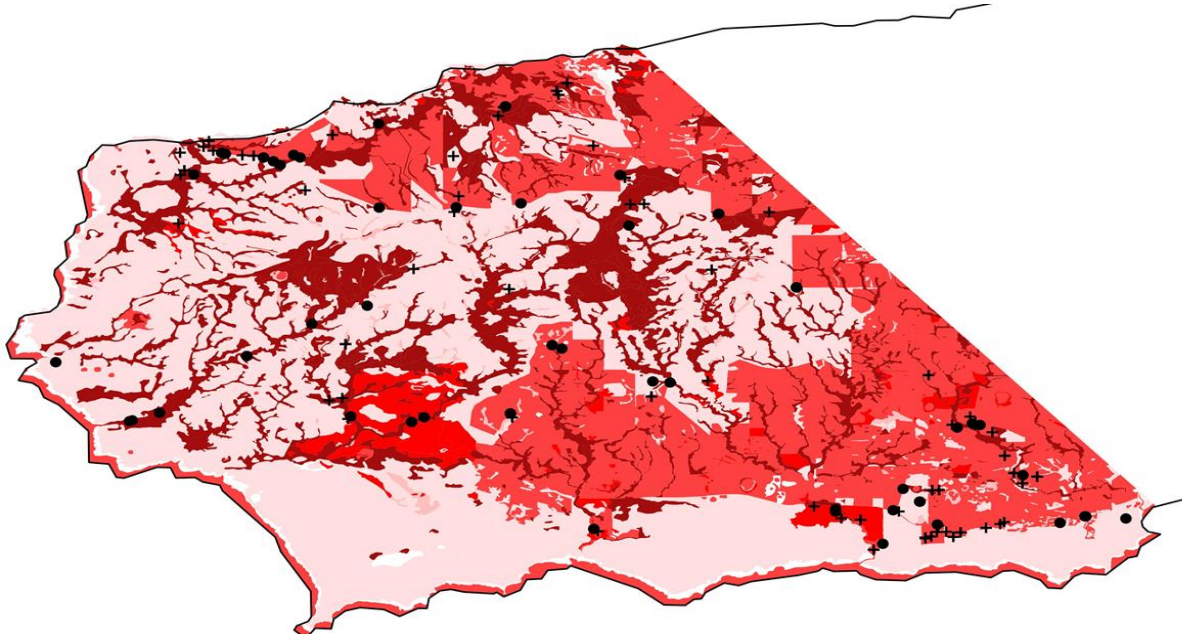
The map below shows the distribution of different habitats (different colours) on western Kangaroo Island. In the figure legend, the habitats are listed in order of those with highest to lowest densities of pigs.



Habitat preferences

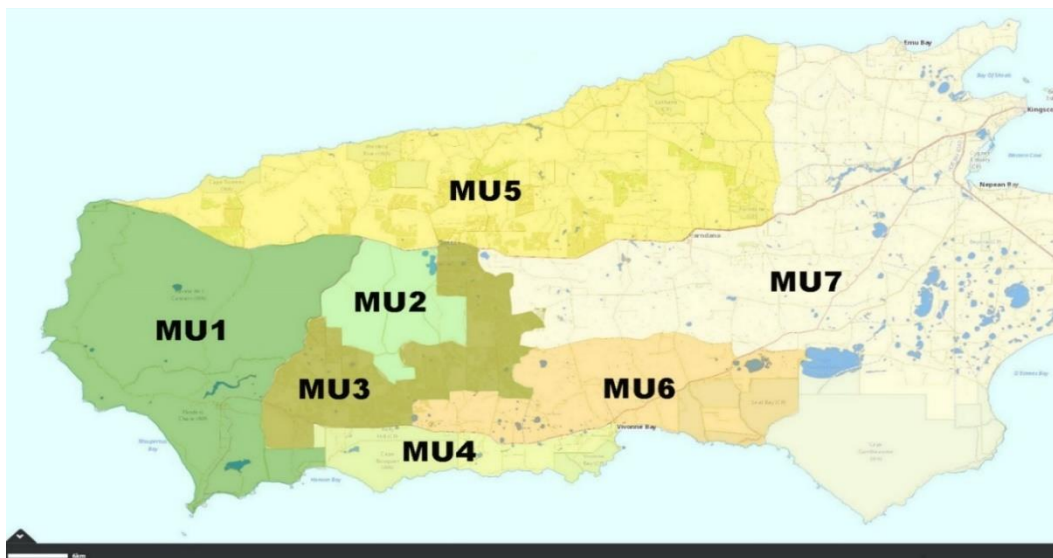
Since the bushfires, 263 pigs have been culled, and 137 have been sighted (some of which might have been double-counted when culled). The locations where pigs were culled or sighted were used to model the preferred habitats of pigs in western Kangaroo Island.

The estimated densities of pigs in each of the habitats are depicted below. Preferred habitats are coloured in darker red (the coastal strip is low-quality habitat, which is erroneously coloured red below). The map includes locations where pigs were sighted (round dots) and culled (+) since January 2020.

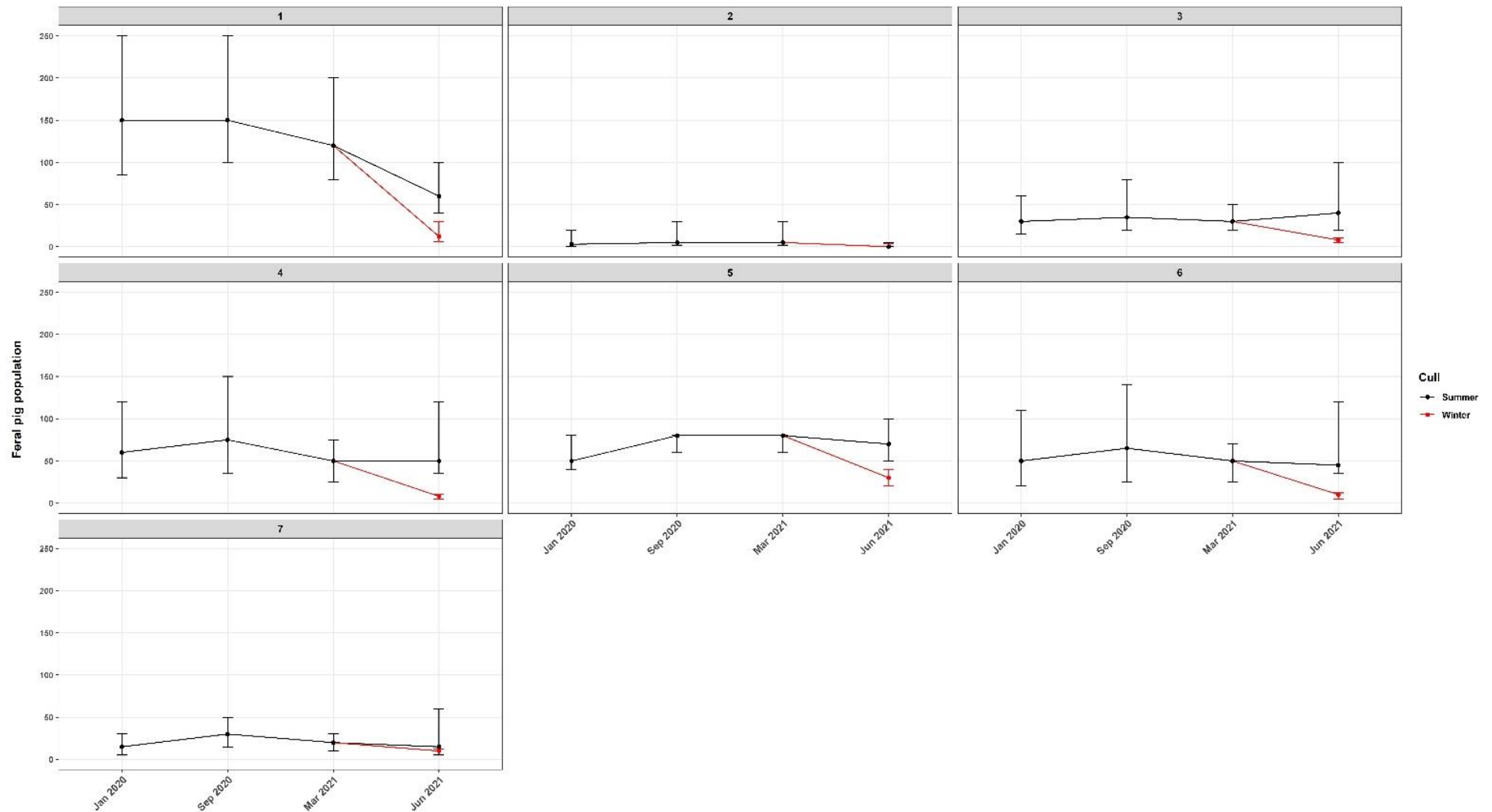


Numbers of pigs in Management Units

The program is implemented in discrete management units, which are based on dominant land uses, and bounded by roads and/or pest-proof fencing (see map below where management units are numbered 1 to 7). Control tools are applied differently across these management units, depending on the abundance of pigs, land use, accessibility and landholder preferences.



Numbers of pigs in each Management Unit were estimated at four points: Immediately following the bushfire in January 2020, September 2020 and March 2021, and predicted in June 2021 for Scenario 2 (black line) and Scenario 3 (red line).



Sighting probability of pigs using different methods

Models required estimates of the sighting probability for all of the ways that pigs have been observed. These estimates of this probability change seasonally as outlined below.

- Farmers and other landholders detecting pigs on their properties:
 - o Summer: 60 per cent chance of seeing a pig or sign of it on their property.
 - o Winter: 95 per cent chance of seeing a pig or sign of it on their property. The increase is a result of obvious pig diggings.
- Thermal-assisted aerial surveys:
 - o Summer: 90 per cent chance of seeing a pig if they fly over it.
 - o Winter: 95 per cent chance of seeing a pig if they fly over it.
- Some “sightings” come from pig feeding stations, where there are motion-sensor cameras.
 - o 100 per cent chance of seeing these pigs. These are the pigs that have already been “found” and free-feed and camera is the beginning of the process to either trap/bait/shoot.

Impacts of culling activities on pig numbers

The impacts of culling activities were estimated based on:

- The numbers of pigs trapped, baited and shot were estimated based on the number and percentage of pigs removed using these techniques between January 2020 and March 2021.
- Thermal-assisted aerial culling impact = estimated pig density of each different habitat × 90 per cent (sighting probability) × area of each different habitat surveyed during the thermal-assisted aerial cull.
- Stochastic projection with 100,000 iterations was used to estimate confidence limits of predictions, assuming 5 per cent variations in: kill rates, carrying capacity, rate of maximum increase, and the percentages of pigs moving among different habitat-quality categories.
- Functional responses (increasing effort and costs per pig with declining densities) were not modelled, because the baiting, trapping, shooting and thermal-assisted aerial culls were deemed to be so effective that costs would not exponentially increase as the pig population declined.

R code used for scenario modelling

The R code to simulate effect of different culling regimes on feral pig populations on Kangaroo Island, South Australia is available at this site <https://github.com/cjabradshaw/KIpigCull>

