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Red imported fire ants - the benefits of avoiding a national disaster

The Red Imported Fire Ant (RIFA) has the potential to become one of Australia's most noxious invasive species. Australia's national eradication program is not sufficiently resourced. Government-commissioned economic analysis suggests the economic case for RIFA eradication is marginal. The main flaw in this modelling is that it only covers a 15-year time period. Extending this same modelling to a 20-year period results in increased benefits of RIFA eradication of between $3 and $9 for every dollar spent.

Discussion paper

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Summary

Red Imported Fire Ants (RIFA) are one of the world's most notorious invasive species. They inflict a painful sting, occasionally cause fatalities, and have caused enormous environmental, social and economic damage in the countries they have colonised.

Australia has managed to supress several outbreaks of RIFA since they first appeared, at the port of Brisbane, in 2001. But in 2023, an outbreak of RIFA breeched containment lines in an unprecedent way, and this pest now threatens to spread beyond southeast Queensland. Almost all of Australia is climatically suitable for RIFA, and without an increased eradication effort, their spread could soon become impossible to contain.

The National Fire Ant Eradication Program, which is co-managed between the Commonwealth, state and territory governments, aims to eradicate this serious pest from Australia by 2032. These combined governments have jointly contributed $592.8 million for the first four years of the program. However, advice to the eradication committee (through the 2021 *National Red Imported Fire Ant Eradication Program Strategic Review*) is that the eradication program be given a significantly higher budget – of between $200 million and $300 million per year, every year for ten years. This review says this is necessary to "avert, by 2032, predicted annual impact and control costs of $2 billion, and up to 140,000 medical consultations and 3,000 anaphylactic reactions each year due to RIFA stings." Clearly, funding must be increased if Australia is to avoid the ravages of RIFA.

We suggest that one of the reasons that the eradication plan has gone underfunded is that the latest cost-benefit analysis – commissioned by Biosecurity Queensland of Department of Agriculture and Fisheries, titled *Assessing the Impacts of the Red Imported Fire Ant* and published in 2021 – downplays the economic case for urgent action.

We identify two initial methodological problems with this report:

- The study limits its analysis to 15 years, even though the vast bulk of the costs will be incurred beyond that period. Other studies of RIFA economics normally use from 20 to 30-year timeframes.
- The study applies three discount rates, the largest of which, 7%, is unreasonably high for a public social and environmental project.

The result of these methodological decisions is misleadingly small net present values. In fact, under one possible scenario, the report even suggests that there could be a negative net present value of RIFA eradication.

To address these limitations, in this report we extended the timeline of Biosecurity Queensland's study by five years. All other assumptions remained the same, and we used

the same three discount rates (2%, 5% and 7%). By making this one small change in timeframe we have calculated much higher net present values and cost benefit ratios that strongly support the cost of eradicating RIFA now:

Cost-benefit analysis over 20 years

	$300 million per year program				$200 million per year program			
	5 km per year spread model		48 km per year spread model		5 km per year spread model		48 km per year spread model	
Discount rate	Net present value ($m)	Benefit-cost ratio	Net present value ($m)	Benefit-cost ratio	Net present value($m)	Benefit-cost ratio	Net present value($m)	Benefit-cost ratio
7%	3,318	2.57:1	5,122	3.43:1	4,020	3.86:1	5,824	5.15:1
5%	5,113	3.21:1	7,585	4.27:1	5,885	4.81:1	8,357	6.41:1
2%	9,392	4.49:1	13,413	5.98:1	10,290	6.73:1	14,311	8.97:1

By simply extending the analysis of the latest government-commissioned modelling, the economic case for RIFA eradication goes from marginal to compelling. For every dollar spent eradicating the ants, the public benefit is between $3 and $9.

This analysis shows that RIFA will cost Australia more than $22 billion by the 2040s. This means that it is less costly to spend $200 million or even $300 million per year every year for the next ten years (which would be a total of between $2 billion and $3 billion) to eradicate RIFA now.

The Biosecurity Queensland modelling has further flaws – its estimates of environmental and social costs are very low, while distribution and ant mound density functions produce results that are implausibly large. The results reported in its summary table are not consistent with the full results reported in its appendix.

Introduction

Red Imported Fire Ants (RIFA) have the potential to inflict enormous environmental, social and economic damage. Native to South America, they have become one of the world's most notorious invasive ant species. They inflict a painful sting that can be fatal, cause huge losses to agriculture and other industries, and have disastrous ecological impacts. As RIFA threaten to spread beyond southeast Queensland, eradicating them should be one of the most pressing economic and environmental policy issues in Australia today.

The 2021 *National Red Imported Fire Ant Eradication Program Strategic Review* describes RIFA as a "super pest" and recommends a budget of between $200 million and $300 million per year to eradicate RIFA from South-east Queensland by 2032.[1] The predicted annual impact and control costs of RIFA is around $2 billion, and RIFA stings can cause up to 140,000 medical consultations and 3,000 anaphylactic reactions each year.[2]

Rather than spurring governments into action, the economic literature on RIFA has contributed to the current malaise. For example, one 2014 study complained that respondents to their survey exhibited:

> Heterogeneity in preferences and values for controlling or eradicating the invasive species, indicating that it may be challenging to gain and maintain political support for management options, particularly if these involve large costs or inconvenience to households.[3]

But it is not the preferences of the public that make it hard to gain and maintain political support for action. On the contrary, economic studies that understate the importance of the RIFA challenge undermine the cause for investing in eradication. The latest economic study on RIFA eradication, which was commissioned by the Queensland Government and written by Central Queensland University researchers Megan Star and John Rolfe,[4] is an excellent case in point. It uses a methodology and draws a conclusion that downplays the economic case for urgent action.

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[1] Scott-Orr, Gruber and Zacharin (2021) *National Red Imported Fire Ant Eradication Program Strategic Review August 2021,* https://www.agriculture.gov.au/biosecurity-trade/policy/partnerships/rifa-eradication/strategic-program-review

[2] Scott-Orr, Gruber and Zacharin (2021) *National Red Imported Fire Ant Eradication Program Strategic Review August 2021,* https://www.agriculture.gov.au/biosecurity-trade/policy/partnerships/rifa-eradication/strategic-program-review

[3] Rolfe and Windle (2014) 'Public preferences for controlling an invasive species in public and private spaces', *Land use policy*, p 1, https://www.sciencedirect.com/science/article/abs/pii/S0264837714000775

[4] Star and Rolfe (2021) *Assessing the Impacts of the Red Imported Fire Ant*, Report for Biosecurity Qld, Department of Agriculture and Fisheries.

This paper provides some basic background on Australia's RIFA problem and current policies designed to address it before critiquing the most recent economic study on RIFA eradication and showing how small changes to its methodology result in cost benefit ratios that strongly support RIFA eradication.

Background

THE IMPACTS OF RIFA INCURSIONS

RIFA were first detected in Australia in 2001, when infestations were found at the Port of Brisbane and in suburbs on the other side of the city. Since then, five separate incursions have been successfully eradicated. But in 2023, a large outbreak in southeast Queensland spread beyond containment lines. RIFA have been detected at Mermaid Waters, just 11.5 km north of the border with NSW, and nests have been found at Mudgeeraba, Carrara, Worongary, and Innisplain – all within 18 km of NSW.[5] This rapid spread of red imported fire ants is alarming, and the Invasive Species Council has warned that Australia is nearing the point where eradication will no longer be possible.[6]

RIFA (also known as fire ants, or *Solenopsis Invicta*) are one of the world's most notorious invasive species. Native to South America, RIFA have spread across the Caribbean, to the United States, China, Malaysia and the Philippines.[7] RIFA are a highly adaptive species that can survive in a range of conditions. They can travel overland and underground and can survive through droughts and floods. Almost all of Australia is suitable habitat for RIFA.[8]

In the United States of America, RIFA have caused immense environmental, economic, and ecological damage. They harm livestock and have been found to damage more than 50 commercial food crops.[9] They are responsible for reducing the biodiversity of native flora and fauna, including other ant species. Since they first became established in the 1930s, RIFA have cost the southern part of the United States an estimated USD$8.75 billion annually.[10] There is no reason why RIFA would not have the same impacts in Australia as they have had in other countries.

[5] NSW Government (2023) *$80 million to protect NSW against red imported fire ants,* https://www.nsw.gov.au/media-releases/80-million-to-protect-against-fire-ants

[6] Invasive Species Council (2023) *Alarm bells ringing: Analysis points to funding shortfall ahead of fire ant eradication decision tomorrow*, https://invasives.org.au/media-releases/analysis-points-to-funding-shortfall-ahead-of-fire-ant-eradication-decision-tomorrow/

[7] Magee et al (2016) *Report of the Independent Review Panel*, Independent Review Panel of the National Red Imported Fire Ant Eradication Program, Canberra.

[8] Invasive species council (2023) *Help stop fire ants in their tracks*, https://invasives.org.au/our-work/invasive-insects/ants/red-fire-ants/

[9] Lard et al (2001) *The statewide economic impact of the imported fire ant on the economy of Texas – with special emphasis on the urban areas and crop and livestock sector,* Texas Imported Fire Ant Research and Management Project, Texas A&M University, College Station, Texas.

[10] USDA (2023) *Imported Fire Ant and Household Insects Research: 2023 Annual Report,* https://www.ars.usda.gov/research/project/?accnNo=436291&fy=2023

POLICY RESPONSES TO RIFA IN AUSTRALIA

In response to the current RIFA outbreak, Commonwealth, state and territory governments have formed the National Fire Ant Eradication Program,[11,12] which aims to eradicate RIFA from Australia by 2032.[13] To achieve this target, a Fire Ant Response Plan has been developed to cover the years 2023–27.[14] A total of $592.8 million has been pledged by Commonwealth and state and territory governments to fund the Plan over this four-year period.[15] However, a 2021 report prepared for the Steering Committee of the National Red Imported Fire Ant Eradication Program estimates that it will cost between $200 million and $300 million per year, every year for ten years, to eradicate RIFA in Australia.[16] To just supress RIFA would cost slightly less; $150 million to $250 million per year every year for ten years. Either way, governments have yet to give the National Fire Ant Eradication Program this level of funding.

PAST ECONOMIC STUDIES ABOUT RIFA

To date, there have been four significant studies on the economics of management and eradication of RIFA in Australia.

- Kompas and Che (2001)[17] assess the expected costs and benefits of eradicating RIFA from Australia. They conclude that the total value of the potential cost of RIFA over 30 years would be around $8.9 billion, or $2.8 billion in present value terms. To avoid this cost, Kompas and Che find that $110 million would need to be spent to eradicate RIFA, resulting in a benefit-cost ratio (BCR) of 25:1. However, they did not include quantitative assessment of potential environmental impacts and they

[11] Australian Government (2024) *National Management Group for the National Fire Ant Eradication Program*, https://www.agriculture.gov.au/biosecurity-trade/policy/partnerships/rifa-eradication

[12] National Fire Ant Eradication Program (2024) *National Management Group*, https://www.fireants.org.au/home/about-us/national-management-group

[13] Australian Government (2023) *National Management Group for the National Fire Ant Eradication Program*, https://www.agriculture.gov.au/biosecurity-trade/policy/partnerships/rifa-eradication#:~:text=The%20National%20Fire%20Ant%20Eradication%20Program%20(the%20Program)%20aims%20to,program%2Dled%20and%20community%20treatment.

[14] National Fire Ant Eradication Program (2024) *Fire Ant Response Plan 2023–27*, https://www.fireants.org.au/home/about-us/fire-ant-response-plan

[15] Australian Government (2024) *Funding, eradication priorities in fight against fire ants*, https://minister.agriculture.gov.au/watt/media-releases/funding-eradication-fire-ants

[16] Scott-Orr, Gruber and Zacharin (2021) *National Red Imported Fire Ant Eradication Program Strategic Review August 2021.*

[17] Note: this paper does not appear to be publicly available. Discussion here is based on a secondary report in Antony et al (2009). Kompas and Che (2001) *An economic assessment of the potential costs of red imported fire ants in Australia*, Report for Department of Primary Industries, Queensland.

estimate the cost based mainly on costs experienced in the US not Australia. This study is likely, therefore, to understate the benefit of RIFA eradication.[18]

- Antony et al (2009)[19] extend Kompas and Che's analysis by adding quantitative indicators of the potential environmental impact of RIFA. This allows them to re-evaluate and update the cost caused by uncontrolled spread of RIFA, which they put at $45 billion in present value terms. This results in a BCR of 390:1 over a 30-year period.
- Hafi et al (2013)[20] evaluate the cost of a RIFA outbreak in Brisbane, the Gold Coast, the Sunshine Coast and West Moreton. They estimate that with no publicly funded control, RIFA would cause economic losses totalling $8.5 billion in 2012 dollars (with a discount rate of 7%), or $25.8 billion in 2012 dollars (with a discount rate of 5%). They find that the net present value (NPV) of eradication programs ranged from $5.168 billion to $8.389 billion, and that BCR ranged from 18.6:1 to 65.5:1.

While these studies calculated the wider national benefits of eradicating RIFA, these calculations do not include other benefits such as the avoided cost of protecting national public infrastructure, the technical and research spillover benefits to Australia, and other social benefits.[21] Despite this, all three of these studies conclude that it is worth spending the money to eradicate RIFA. That they do so even though all three also underestimate the long-term costs at the national level shows just how important it is to act now.

In contrast, the latest government-commissioned study for Biosecurity Queensland[22] casts doubt over whether the costs of eradicating fire ants are worth the benefits. This study found that eradication has net present values that are small or even negative. The remainder of our paper will focus on discussing this study in detail.

[18] Antony et al (2009) *Revised benefits and costs of eradicating the red imported fire ant*, paper presented at the 53rd annual conference of the Australian Agricultural and Resource Economics Society, 10–13 February 2009, Cairns, Australia, https://www.researchgate.net/publication/38392029_Revised_benefits_and_costs_of_eradicating_the_red_imported_fire_ant

[19] Antony et al (2009) *Revised benefits and costs of eradicating the red imported fire ant.*

[20] Hafi et al (2013) *Cost-effectiveness of biosecurity response options to red imported fire ants in South East Queensland*, ABARES report for the National Biosecurity Committee, Canberra, https://www.agriculture.gov.au/abares/research-topics/biosecurity/biosecurity-economics/red-imported-fire-ants.

[21] Magee et al (2016) *Report of the Independent Review Panel, Independent Review Panel of the National Red Imported Fire Ant Eradication Program*, Canberra, https://digital.library.adelaide.edu.au/dspace/handle/2440/106245

[22] Star and Rolfe (2021) *Assessing the Impacts of the Red Imported Fire Ant*.

Biosecurity Queensland RIFA study

The most recent government-commissioned study of RIFA in Australia was 2021 research for Biosecurity Queensland by Central Queensland University researchers Megan Star and John Rolfe, titled *Assessing the Impacts of the Red Imported Fire Ant*. Depending on the specific scenario (including rate of spread and discount rate), this study found that that BCR of RIFA eradication vary from between 0.86:1 and 15.66:1. Tables 1 and 2 and Figures 2 and 3 summarise Biosecurity Queensland's reported results.[23]

Table 1: Cost-benefit analysis at $300 million annual eradication program, 2021-35

Discount rate	5 km per year spread model		48 km per year spread model	
	NPV ($m)	BCR	NPV ($m)	BCR
7%	-302.70	0.86:1	430	4.65:1
5%	243.80	1.12:1	1,203.20	6.06:1
2%	619	1.29:1	3.583.7	10.44:1

Source: Star and Rolfe (2021) *Assessing the Impacts of the Red Imported Fire Ant*

Table 2: Cost-benefit analysis at $200 million annual eradication program, 2021-35

Discount rate	5 km per year spread model		48 km per year spread model	
	NPV ($m)	BCR	NPV ($m)	BCR
7%	399.60	1.28:1	1,132.30	6.97:1
5%	946.10	1.67:1	1,905.50	9.1:1
2%	1,321.40	1.94:1	4,286.20	15.66:1

Source: Star and Rolfe (2021) *Assessing the Impacts of the Red Imported Fire Ant*

These results give the impression that there is not a strong economic case for eradication. In one scenario in Table 1, the net present value is negative, suggesting that it might not be worth investing in RIFA eradication at all. This conclusion is, to put it mildly, contrary to both the recommendations of the *National Red Imported Fire Ant Eradication Program Strategic Review* and the stated views of almost every stakeholder involved in this problem.

Biosecurity Queensland's analysis and conclusions are deeply flawed. The following sections explain their analysis and set out different conclusions.

[23] Note here that in the final section of this report we show that Star and Rolfe's results reported here are inconsistent with the full results they report in their appendix C.

UNDERSTANDING BIOSECURITY QUEENSLAND'S MODELING

It is no small task to conduct the kind of analysis attempted by Star and Rolfe. It involves estimating many complex values and applying them over a wide area. However, there are major flaws in Star and Rolfe's work that call into question the validity of their findings.

15-year timeframe

The previous cost-benefit analyses of RIFA eradication in Australia looked at a time period of 20 to 30 years. Star and Rolfe, however, limited their cost-benefit analysis to a 15-year time frame. The only justification they give for this decision is the following:

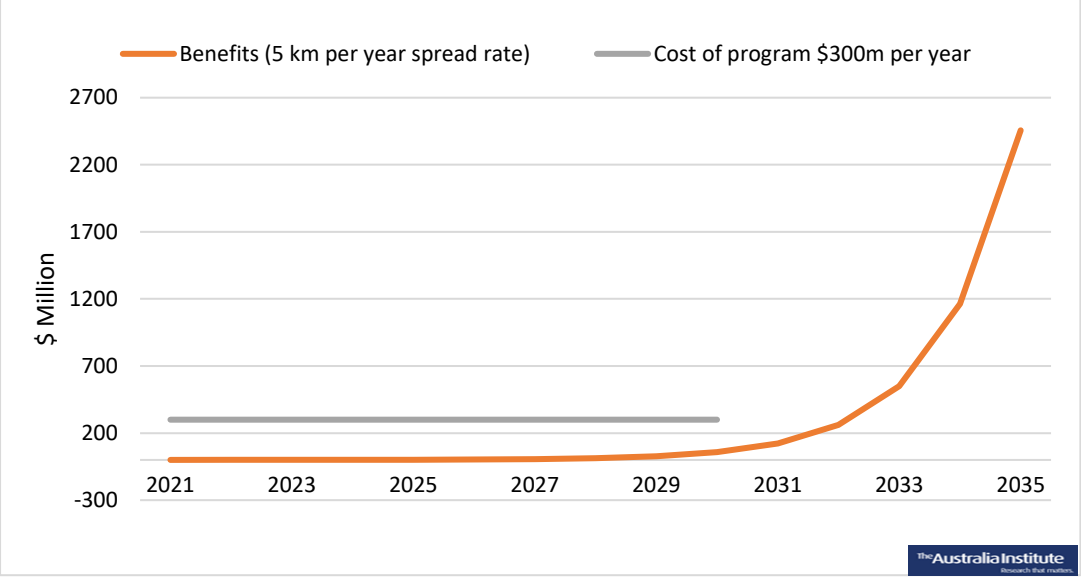
> A 15-year time period has been chosen for analysis, even though only a small proportion of total potential infestation would occur in this time period, so as to maintain relevance for current decision makers and budget allocations.[24]

A timeline of 15 years is not long enough to properly account for the damage RIFA will cause to Australia as a whole because fire ants could only spread over a relatively small part of Australia within this time frame, which means that a high proportion of the costs would occur beyond 15 years. By limiting their analysis to 15 years, Star and Rolfe significantly underestimate the ultimate costs of RIFA and the corresponding benefits of their eradication. This is why most of their net present values (NPV) are so small, and why one is even negative.

The importance of the timeframe can be seen clearly when Star and Rolfe's costs and benefits are graphed. Figure 1 below shows the timing of costs and benefits of the scenario estimated by Star and Rolfe to have negative NPV.

[24] Star and Rolfe (2021) *Assessing the Impacts of the Red Imported Fire Ant*, p 5.

Figure 1: $300 million per year eradication program costs and benefits

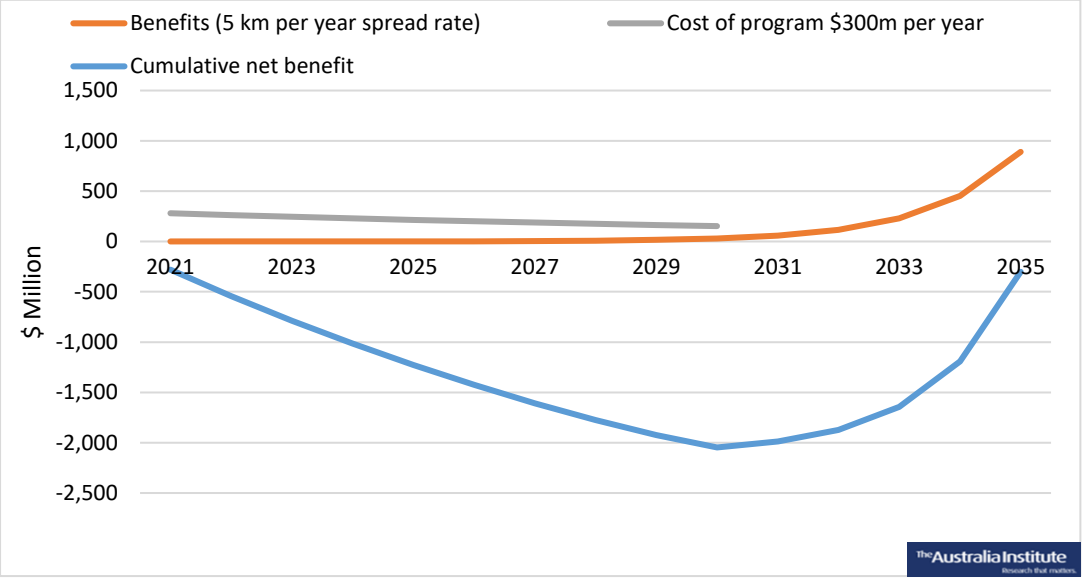


Source: Star and Rolfe (2021) *Assessing the Impacts of the Red Imported Fire Ant*

Figure 1 shows that the financial costs of the eradication program are $300 million per year for the first ten years of the analysis period. During this time, Star and Rolfe estimate that the benefits of the program are small – at best less than $1 million per year for the first four years, reaching potentially $58 million in year 10. Just as benefits begin to increase exponentially, $2.5 billion in year 15, the analysis ends.

Figure 2 below graphs Star and Rolfe's results including present value cumulative net benefit. In the scenario with a $300 million per year program spend and 5 km per year ant spread model, net benefits reach negative $302 million in year 15, having plumbed the depths of negative $2 billion.

Figure 2: Cumulative net benefits of eradication $300m, 5km per year spread, 15 years



Note: discount rate 7%. Source: Star and Rolfe (2021) *Assessing the Impacts of the Red Imported Fire Ant*

Star and Rolfe note that "all benefit cost analyses of eradication are positive by year 16,"[25] a finding that is clear from Figure 2. Yet Star and Rolfe include no sensitivity analysis around timeframe and provide no further justification for their choice of time frame.

Discount rates

Star and Rolfe use the baseline discount rates recommended by the Office of Best Practice Regulation this is 7% or, for sensitive analyses, the lower discount rates of 2% and 5%.[26]

By their own acknowledgement, a 7% discount rate may overstate the true opportunity cost. This is because the (then contemporary) 2021 Australian Government borrowing rate is much lower (between 2% and 5%).[27] Moreover, Star and Rolfe acknowledge that overestimating the discount rate can result in a substantial underestimation of eradication benefits because benefits are obtained over the long-term future, whereas costs are incurred sooner.[28]

We fully agree that the discount rate of 7% is too high for a public social environmental project. Rates of approximately 2% are generally more common among long-term public

[25] Star and Rolfe (2021) *Assessing the Impacts of the Red Imported Fire Ant*, p 33.
[26] Star and Rolfe (2021*) Assessing the Impacts of the Red Imported Fire Ant*, p 20.
[27] Star and Rolfe (2021) *Assessing the Impacts of the Red Imported Fire Ant*, p 21.
[28] Star and Rolfe (2021) *Assessing the Impacts of the Red Imported Fire Ant*, p 21.

project.[29] As the economic benefits of investing in long-term public projects are highly sensitive to the social discount rate, applying a discount rate of 7% leads to a significant underestimation of net present values and small cost-benefit ratios.

Cost estimations

To estimate the total annual costs caused by RIFA, Star and Rolfe use a per-household and a per-hectare measure. These costs would be affected differently under the two different spread rates that Star and Rolfe propose: 5 km per year and 48 km per year. The current rate of spread is 5 km per year, while 48 km per year is the distance a queen fire ant and a minimum of six worker drones can fly in a year. These costs include:

Control costs (of mitigating RIFA):

- Pesticide expenditures by households.
- Changed commercial activities by industries, such as washing harvesting machinery or restricting movements of vehicles.
- Treatment costs incurred by government in protecting the environment.

Damages (losses other than control costs):

- Losses of wellbeing to people living in or visiting areas affected by RIFA.
- Losses of wellbeing to people from loss or degradation of environmental assets.
- Crop losses to agricultural industries.

But the values Star and Rolfe attribute to these costs are, in our estimation, far too small. For example, they estimate households' willingness to pay for avoiding losses of natural bushland at just $0.08 for 100 ha, and the amount households would be willing to pay to avoid infestations at $0.99 per 1,000 houses. This is implausible given that Star and Rolfe estimate a damage cost of $32 per year per household for damage to electrical systems alone.

Cost of eradication program

To calculate the cost of eradication, Star and Rolfe relied on the figure of $200 million to $300 million per year, every year for ten years given, which Biosecurity Queensland provided them. These numbers are the same as those in Scott-Orr, Gruber and Zacharin

[29] Drupp et al (2018) 'Discounting Disentangled.' *American Economic Journal: Economic Policy*, https://doi.org/10.1257/pol.20160240

(2021),[30] which were provided as formal advice in the National Red Imported Fire Ant Eradication Program Strategic Review August 2021.

The benefit of the eradication program

Star and Rolfe include a calculation of what they call the "no control" option – which would mean not investing any government money into an eradication program and allowing RIFA to spread unchecked. They treat the sum of avoided costs from this "no control" option as the benefits for the eradication programs in both the 48 km scenario and the 5 km scenario. They say that the annual benefits of eradication are equal to the annual total costs that would be caused by taking the "no control" option for 15 years.[31] However, we argue that the avoided costs cannot be equal to 100% of the total costs from the "no control" option from year 1 to year 10 because the program would not have eradicated RIFA within that timeframe. RIFA still cause costs from year 1 to year 10, but their costs should be smaller than those that Star and Rolfe give in their "no control" option.

[30] Scott-Orr, Gruber and Zacharin (2021) *National Red Imported Fire Ant Eradication Program Strategic Review August 2021*.

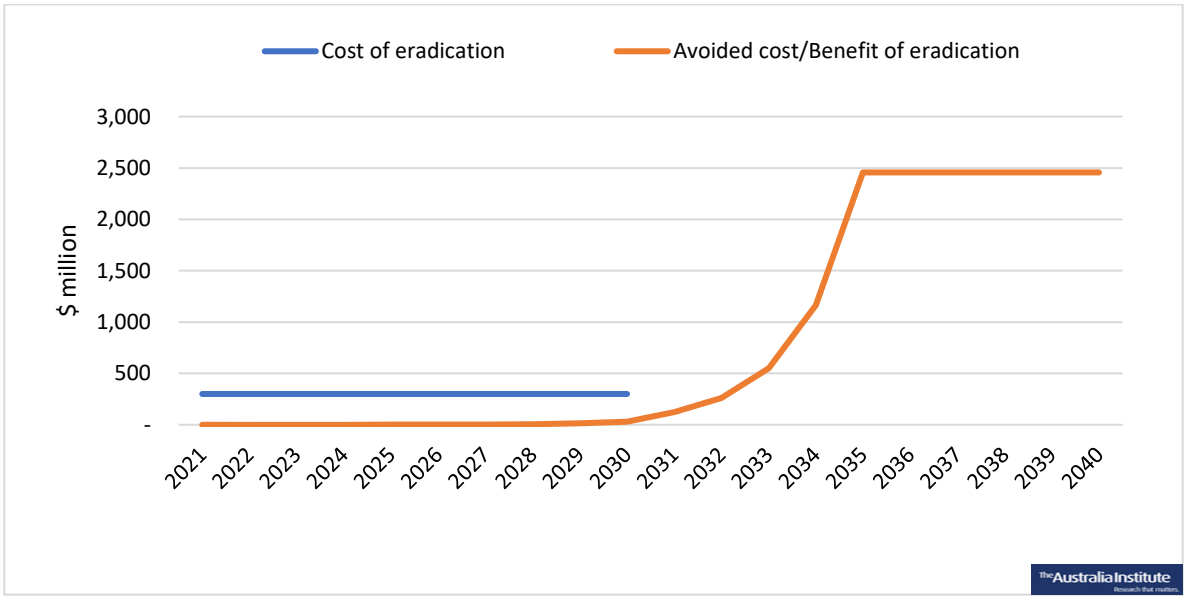
[31] Star and Rolfe (2021) *Assessing the Impacts of the Red Imported Fire Ant*, p 20.

RIFA eradication over 20 years

Of the above, the most significant flaw in Star and Rolfe's report is the limitation of analysis to a 15-year time period. Our original calculations extend Star and Rolfe's analysis by just five more years. By making this one small amendment, we show that the long-term benefits of eradication far outweigh the up-front costs.

Although the benefits of eradication should be higher beyond the 15-year period (because the ants would have spread and grown further), we assume that the annual costs in years 16 to 20 remain the same as in year 15. This means we have underestimated avoided costs and damages that Star and Rolfe's model would predict over the additional five years. Figure 3 below plots this change for comparison with Star and Rolfe's estimates of the $300 million per year program and 5 km per year spread model, shown above.

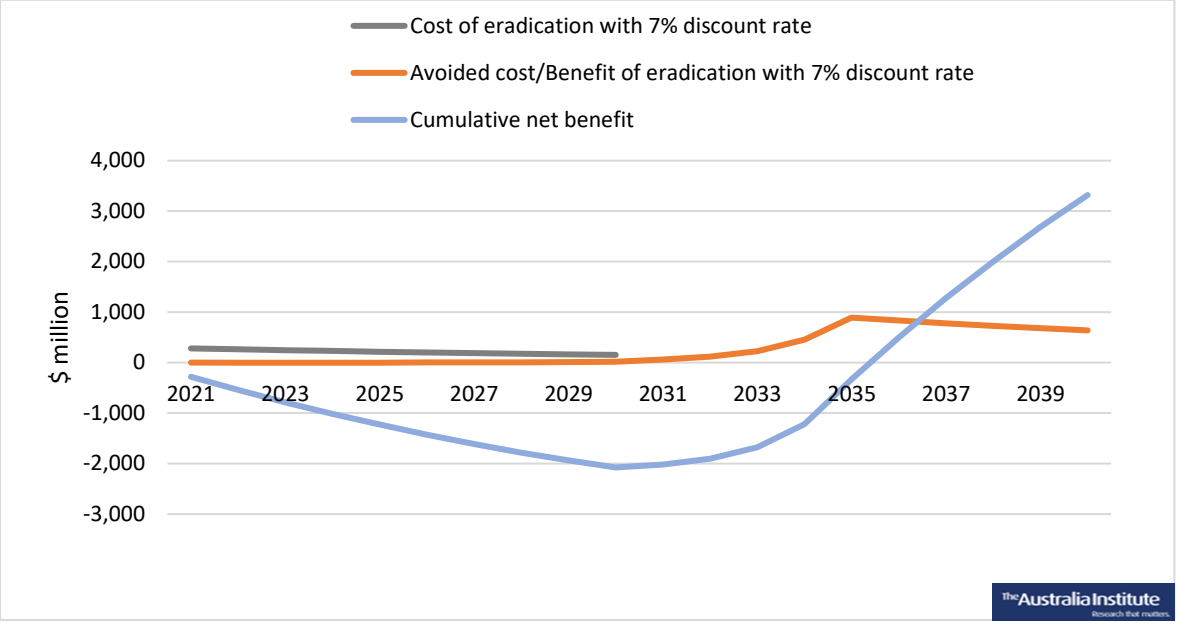
Figure 3: Costs and benefits of RIFA eradication over 20 years



Source: Star and& Rolfe (2021) *Assessing the Impacts of the Red Imported Fire Ant*

Taking this approach, the cumulative net benefit of the project is positive in year 16, as noted by Star and Rolfe, and reaches positive $3.3 billion in year 20, as shown in Figure 4 below.

Figure 4: Cumulative net benefits of eradication $300m, 5km per year spread, 20 years



Note: discount rate 7%. Source: Star and Rolfe (2021) *Assessing the Impacts of the Red Imported Fire Ant*; Author calculations

The only other minor change made to Star and Rolfe's model in the above calculations is that we assume that the avoided costs or the benefit of eradication would be half of the price that fire ants could cause in the "no control" option from year 1 to year 10. Beyond that, from years 11 to year 20, the eradication program can help to reduce the costs and damages of RIFA to zero because, from year 11, RIFA should have been eradicated. All of our other assumptions remain the same as Star and Rolfe, including the 2%, 5% and 7% discount rates, the 5 km per year and 48 km per year rate of spread, and the annual $200 million to $300 million cost of eradication.

Tables 4 and 5 show Star and Rolfe's cost-benefit analysis of RIFA eradication programs extended to 20 years. In all scenarios, the net present values of the program are positive and large. The benefit-cost ratios – of between 2.57:1 to 8.97:1 – are also much greater than one. This means that there is a strong economic case for the eradication of RIFA now rather than dealing with the problems they will cause in 20 years' time.

Table 4: Cost-benefit analysis in 20 years

	$300 million per year program				$200 million per year program			
Discount rate	5 km per year spread model		48 km per year spread model		5 km per year spread model		48 km per year spread model	
	NPV ($m)	BCR	NPV ($m)	BCR	NPV ($m)	BCR	NPV ($m)	BCR
7%	3,318	2.57:1	5,122	3.43:1	4,020	3.86:1	5,824	5.15:1
5%	5,113	3.21:1	7,585	4.27:1	5,885	4.81:1	8,357	6.41:1
2%	9,392	4.49:1	13,413	5.98:1	10,290	6.73:1	14,311	8.97:1

Source: The Australia Institute's estimation.

Even if we underestimate the avoided costs and damages of RIFA uncontrolled or the benefit of RIFA eradication program, the cost and benefit analysis still provide results that strongly support the RIFA eradication program. So, spending $200 million to $300 million per year for ten years to eradicate RIFA is worth doing under any of these scenarios. We must spend this money to protect Australia from having to spend billions of dollars to deal with a much bigger problem in the future.

Further flaws in Star and Rolfe

In our view, and the view of every stakeholder that we have encountered, the case for RIFA eradication and long-term prevention is compelling. The above analysis makes the simple point that while the latest government-commissioned modelling appears to suggest that the case for eradication is marginal, in fact, with a small adjustment to modelling assumptions, this analysis also supports strong action on RIFA.

Without undermining this overall conclusion, we feel compelled to point out further flaws in the Star and Rolfe analysis that suggest their whole study is not suitable for policy making purposes.

First, the functions used to model the spread and density of RIFA produce results that are nonsensical. Figure 5 below is screen shot from Star and Rolfe's report.

Figure 5: Extract from Star and Rolfe – spread and density function results

Time Periods	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00
Ant mounds	1.55	3.72	13.87	80.04	716.10	9930.38	21344 5.77	711117 1.20	3672200 77.28	293929651 25.51	3646633180 216.96	70124932670 5416.00	2090184069931 85000.00	965669040057393 00000.00	69151846381713600 000000.00
m2	1.80	5.83	34.01	357.05	6746.64	2294 68.25	14048 506.05	154813 9828.43	3070879 17757.37	109644734 604489.00	7046692766 5898700.00	81518353276 600100000.00	1697453806186 01000000000.00	636228377411602 000000000000.00	42924042124006600 00000000000000.00
Mounds per m2	1.16	1.57	2.45	4.46	9.42	23.11	65.82	217.71	836.25	3730.31	19323.83	116247.32	812107.33	6588472.35	62072156.23
Ha	0.000 0116 1	0.000 0245 2	0.000 0518 0	0.000 1094 0	0.000 2310 8	0.000 4880 8	0.010 3091	0.0217 746	0.04599 19	0.0971433	0.2051842	0.4333862	0.9153903	1.9334701	4.0838392
Proportion of property	0.000 0001 7	0.000 0003 5	0.000 0007 4	0.000 0015 6	0.000 0033 0	0.000 0069 7	0.000 1473	0.0003 111	0.00065 70	0.0013878	0.0029312	0.0061912	0.0130770	0.0276210	0.0583406

Source: Star and Rolfe (2021) Appendix A. Density Function, p 37

The third line of the table in Figure 5 shows the area covered by RIFA in square meters. In year 15 the area of Australia covered is 4,292,404,212,400,660,000,000,000,000,000m^2, more conveniently expressed as 4.3 x 10^{30}. Aside from being an extraordinarily large number, the entire Australian landmass is only 7,656,127 square kilometres, or in square metres 7.7 x 10^{12}.

The number of mounds listed in the second line reaches 6.9 x 10^{22}. Despite being a substantially smaller number than the number of square meters, the third line suggests that there would be 62 million mounds per square metre.

These results are completely implausible and suggest that the model used is not fit for purpose.

Perhaps relatedly, a further flaw in the Star and Rolfe report is that most of the reported final results, net present values and cost benefit ratios, are inconsistent with the "full results" reported in Appendix C. Table 5 below compares the results reported in Star and

Rolfe's Tables 12 and 13 with the same figures calculated from the full results tables in Appendix C. For convenience, results that match (or where the difference could be a result of a rounding error) between Star and Rolfe's Tables 12 and 13 and Appendix C are shaded green, results that cannot be reconciled are shaded pink.

Table 5: Comparison of reported results and calculations based on full results

	$300 million per year program NPV			
Discount rate	5 km per year spread model		48 km per year spread model	
	Table 12	Appendix C	Table 12	Appendix C
7%	-302.7	-302.7	430.0	295.9
5%	243.8	33.1	1,203.2	812.8
2%	619.0	835.0	3,583.7	2,006.6
	$200 million per year program NPV			
Discount rate	5 km per year spread model		48 km per year spread model	
	Table 13	Appendix C	Table 13	Appendix C
7%	399.6	399.6	1,132.3	998.3
5%	946.1	805.3	1,905.5	1,584.9
2%	1,321.4	1,733.2	4,286.2	2,904.9
	$300 million per year program BCR			
Discount rate	5 km per year spread model		48 km per year spread model	
	Table 12	Appendix C	Table 12	Appendix C
7%	0.86	0.86	4.65	1.14
5%	1.12	1.01	6.06	1.35
2%	1.29	1.31	10.44	1.74
	$200 million per year program BCR			
Discount rate	5 km per year spread model		48 km per year spread model	
	Table 13	Appendix C	Table 13	Appendix C
7%	1.28	1.28	6.97	1.71
5%	1.67	1.52	9.10	2.03
2%	1.94	1.96	15.66	2.62

Source: Star and Rolfe (2021) *Assessing the Impacts of the Red Imported Fire Ant*

To explore just one example, consider Table 6 below which reproduces two scenarios reported in Star and Rolfe's Table 13:

Table 6: Cost-benefit analysis of $200 million annual eradication program, 2021–35

Discount rate	5 km per year spread model		48 km per year spread model	
	NPV ($million)	BCR	NPV ($million)	BCR
7%	399.60	1.28:1	1,132.30	6.97:1

Source: Star and Rolfe (2021) *Assessing the Impacts of the Red Imported Fire Ant*

In Table 6 there are two scenarios:

(i) 5 km per year spread rate, 7% discount rate, $200 million per year for ten years, and 15-year timeframe, and

(ii) 48 km per year rate, 7% discount rate, $200million per year for ten years, and 15-year timeframe.

The only distinction between the two cases is the spreading rate. Given that eradication costs are the same in both cases, but the annual benefits of eradication are approximately 1.3 times higher under the 48 km per year rate of spread, the BCR should also be around 1.3 times higher. However, in Star and Rolfe's study, BCR of scenario two is calculated as 6.97, which is 5.44 times as high as BCR of 1.28 of case one. Similar flaws are evident in other scenarios.

It is difficult to know what to make of these inconsistencies. An email to the authors has received a reply that did not explain anything beyond what was in the original methodology of the paper.

Conclusion

The advice given to the Steering Committee of the National Red Imported Fire Ant Eradication Program is that between $200 million and $300 million needs to be spent every year for ten years to eradicate RIFA in Australia.[32] However, the eradication program has so far only been granted $592.8 million for four years. This is clearly not enough to deal with what could prove to be one of Australia's most noxious invasive species but, as our analysis shows, the upfront costs of stopping the spread of RIFA now are significantly less than the price Australians will pay in the 2040s if nothing is done.

[32] Scott-Orr, Gruber and Zacharin (2021) *National Red Imported Fire Ant Eradication Program Strategic Review August 2021.*

Appendix: cost-benefit analyses of RIFA eradication

A REPLICATE OF STAR AND ROLFE'S COST-BENEFIT ANALYSIS

5 km per year spread model

Year	Total cost of RIFA uncontrolled (Star and Rolfe)	Cost of eradication	Avoided cost/Benefit of eradication	Cost of eradication with 7% discount rate	Avoided cost/Benefit of eradication with 7% discount rate	Cost of eradication with 5% discount rate	Avoided cost/Benefit of eradication with 5% discount rate	Cost of eradication with 2% discount rate	Avoided cost/Benefit of eradication with 2% discount rate
1	60,604	300,000,000	60,604	280,373,832	56,639	285,714,286	57,718	294,117,647	59,416
2	147,384	300,000,000	147,384	262,031,618	128,731	272,108,844	133,682	288,350,634	141,661
3	311,302	300,000,000	311,302	244,889,363	254,115	259,151,280	268,914	282,696,700	293,347
4	557,838	300,000,000	557,838	228,868,564	425,572	246,810,742	458,935	277,153,628	515,356
5	1,388,813	300,000,000	1,388,813	213,895,854	990,204	235,057,850	1,088,171	271,719,243	1,257,891
6	2,933,425	300,000,000	2,933,425	199,902,667	1,954,665	223,864,619	2,188,967	266,391,415	2,604,797
7	6,201,132	300,000,000	6,201,132	186,824,923	3,861,753	213,204,399	4,407,029	261,168,054	5,398,459
8	13,097,914	300,000,000	13,097,914	174,602,731	7,623,105	203,051,809	8,865,184	256,047,111	11,178,943
9	27,665,168	300,000,000	27,665,168	163,180,123	15,048,018	193,382,675	17,833,214	251,026,580	23,148,975
10	58,433,848	300,000,000	58,433,848	152,504,788	29,704,805	184,173,976	35,873,314	246,104,490	47,936,108
11	123,422,875		123,422,875		58,637,319		72,162,799		99,264,457
12	260,691,475		260,691,475		115,750,133		145,162,768		205,553,449
13	550,634,425		550,634,425		228,493,710		292,013,192		425,658,320
14	1,163,044,018		1,163,044,018		451,048,522		587,416,261		881,442,014

15	2,456,604,063		2,456,604,063		890,386,364		1,181,668,558		1,825,293,005
Total	**4,665,194,284**	**3,000,000,000**	**4,665,194,284**	**2,107,074,462**	**1,804,363,657**	**2,316,520,479**	**2,349,598,705**	**2,694,775,502**	**3,529,746,196**

Year	Total cost of RIFA uncontrolled	Cost of eradication	Avoided cost/Benefit of eradication	Cost of eradication with 7% discount rate	Avoided cost/Benefit of eradication with 7% discount rate	Cost of eradication with 5% discount rate	Avoided cost/Benefit of eradication with 5% discount rate	Cost of eradication with 2% discount rate	Avoided cost/Benefit of eradication with 2% discount rate
1	60,604	200,000,000	60,604	186,915,888	56,639	190,476,190	57,718	196,078,431	59,416
2	147,384	200,000,000	147,384	174,687,746	128,731	181,405,896	133,682	192,233,756	141,661
3	311,302	200,000,000	311,302	163,259,575	254,115	172,767,520	268,914	188,464,467	293,347
4	557,838	200,000,000	557,838	152,579,042	425,572	164,540,495	458,935	184,769,085	515,356
5	1,388,813	200,000,000	1,388,813	142,597,236	990,204	156,705,233	1,088,171	181,146,162	1,257,891
6	2,933,425	200,000,000	2,933,425	133,268,445	1,954,665	149,243,079	2,188,967	177,594,276	2,604,797
7	6,201,132	200,000,000	6,201,132	124,549,948	3,861,753	142,136,266	4,407,029	174,112,036	5,398,459
8	13,097,914	200,000,000	13,097,914	116,401,821	7,623,105	135,367,872	8,865,184	170,698,074	11,178,943
9	27,665,168	200,000,000	27,665,168	108,786,749	15,048,018	128,921,783	17,833,214	167,351,053	23,148,975
10	58,433,848	200,000,000	58,433,848	101,669,858	29,704,805	122,782,651	35,873,314	164,069,660	47,936,108
11	123,422,875		123,422,875		58,637,319		72,162,799		99,264,457
12	260,691,475		260,691,475		115,750,133		145,162,768		205,553,449
13	550,634,425		550,634,425		228,493,710		292,013,192		425,658,320
14	1,163,044,018		1,163,044,018		451,048,522		587,416,261		881,442,014
15	2,456,604,063		2,456,604,063		890,386,364		1,181,668,558		1,825,293,005
Total	**4,665,194,284**	**2,000,000,000**	**4,665,194,284**	**1,404,716,308**	**1,804,363,657**	**1,544,346,986**	**2,349,598,705**	**1,796,517,001**	**3,529,746,196**

48 km per year spread model

Year	Total cost of RIFA uncontrolled	Cost of eradication	Avoided cost/Benefit of eradication	Cost of eradication with 7% discount rate	Avoided cost/Benefit of eradication with 7% discount rate	Cost of eradication with 5% discount rate	Avoided cost/Benefit of eradication with 5% discount rate	Cost of eradication with 2% discount rate	Avoided cost/Benefit of eradication with 2% discount rate
1	60591	300,000,000	60,591	280,373,832	56,627	285,714,286	57,706	294,117,647	59,403
2	182924	300,000,000	182,924	262,031,618	159,773	272,108,844	165,917	288,350,634	175,821
3	386367	300,000,000	386,367	244,889,363	315,391	259,151,280	333,758	282,696,700	364,082
4	850571	300,000,000	850,571	228,868,564	648,897	246,810,742	699,767	277,153,628	785,796
5	1834510	300,000,000	1,834,510	213,895,854	1,307,980	235,057,850	1,437,387	271,719,243	1,661,572
6	3874816	300,000,000	3,874,816	199,902,667	2,581,954	223,864,619	2,891,447	266,391,415	3,440,726
7	8184315	300,000,000	8,184,315	186,824,923	5,096,780	213,204,399	5,816,440	261,168,054	7,124,939
8	17307786	300,000,000	17,307,786	174,602,731	10,073,289	203,051,809	11,714,591	256,047,111	14,772,029
9	36595029	300,000,000	36,595,029	163,180,123	19,905,271	193,382,675	23,589,482	251,026,580	30,621,083
10	77295333	300,000,000	77,295,333	152,504,788	39,293,028	184,173,976	47,452,629	246,104,490	63,409,095
11	163278562		163,278,562		77,572,469		95,465,594		131,318,912
12	345385939		345,385,939		153,355,487		192,323,815		272,334,456
13	733974107		733,974,107		304,573,160		389,242,140		567,385,857
14	1550297194		1,550,297,194		601,231,981		783,005,430		1,174,931,524
15	3274517170		3,274,517,170		1,186,835,715		1,575,098,747		2,433,014,491
Total	**6,214,025,214**	**3,000,000,000**	**6,214,025,214**	**2,107,074,462**	**2,403,007,800**	**2,316,520,479**	**3,129,294,849**	**2,694,775,502**	**4,701,399,786**

Year	Total cost of RIFA uncontrolled	Cost of eradication	Avoided cost/Benefit of eradication	Cost of eradication with 7% discount rate	Avoided cost/Benefit of eradication with 7% discount rate	Cost of eradication with 5% discount rate	Avoided cost/Benefit of eradication with 5% discount rate	Cost of eradication with 2% discount rate	Avoided cost/Benefit of eradication with 2% discount rate
1	60591	200,000,000	60,591	186,915,888	56,627	190,476,190	57,706	196,078,431	59,403

2	182924	200,000,000	182,924	174,687,746	159,773	181,405,896	165,917	192,233,756	175,821
3	386367	200,000,000	386,367	163,259,575	315,391	172,767,520	333,758	188,464,467	364,082
4	850571	200,000,000	850,571	152,579,042	648,897	164,540,495	699,767	184,769,085	785,796
5	1834510	200,000,000	1,834,510	142,597,236	1,307,980	156,705,233	1,437,387	181,146,162	1,661,572
6	3874816	200,000,000	3,874,816	133,268,445	2,581,954	149,243,079	2,891,447	177,594,276	3,440,726
7	8184315	200,000,000	8,184,315	124,549,948	5,096,780	142,136,266	5,816,440	174,112,036	7,124,939
8	17307786	200,000,000	17,307,786	116,401,821	10,073,289	135,367,872	11,714,591	170,698,074	14,772,029
9	36595029	200,000,000	36,595,029	108,786,749	19,905,271	128,921,783	23,589,482	167,351,053	30,621,083
10	77295333	200,000,000	77,295,333	101,669,858	39,293,028	122,782,651	47,452,629	164,069,660	63,409,095
11	163278562		163,278,562		77,572,469		95,465,594		131,318,912
12	345385939		345,385,939		153,355,487		192,323,815		272,334,456
13	733974107		733,974,107		304,573,160		389,242,140		567,385,857
14	1550297194		1,550,297,194		601,231,981		783,005,430		1,174,931,524
15	3274517170		3,274,517,170		1,186,835,715		1,575,098,747		2,433,014,491
Total	**6,214,025,214**	**2,000,000,000**	**6,214,025,214**	**1,404,716,308**	**2,403,007,800**	**1,544,346,986**	**3,129,294,849**	**1,796,517,001**	**4,701,399,786**

Summary of CBA results

	$300 million per year program				$200 per year program			
Discount rate	5km per year spread model		48km per year spread model		5km per year spread model		48km per year spread model	
	Net present value ($m)	Benefit-cost ratio	Net present value($m)	Benefit-cost ratio	Net present value($m)	Benefit-cost ratio	Net present value($m)	Benefit-cost ratio
7%	-302.71	0.86	295.93	1.14	399.65	1.28	998.29	1.71
5%	33.08	1.01	812.77	1.35	805.25	1.52	1,584.95	2.03
2%	834.97	1.31	2,006.62	1.74	1,733.23	1.96	2,904.88	2.62

OUR EXTENDED COST-BENEFIT ANALYSIS

5km per year spread model

Year	Total cost of RIFA uncontrolled	RIFA damage costs with eradication program	Cost of eradication	Avoided cost/Benefit of eradication	Cost of eradication with 7% discount rate	Avoided cost/Benefit of eradication with 7% discount rate	Cost of eradication with 5% discount rate	Avoided cost/Benefit of eradication with 5% discount rate	Cost of eradication with 2% discount rate	Avoided cost/Benefit of eradication with 2% discount rate
1	60,604	30,302	300,000,000	30,302	280,373,832	28,320	285,714,286	28,859	294,117,647	29,708
2	147,384	73,692	300,000,000	73,692	262,031,618	64,365	272,108,844	66,841	288,350,634	70,830
3	311,302	155,651	300,000,000	155,651	244,889,363	127,058	259,151,280	134,457	282,696,700	146,673
4	557,838	278,919	300,000,000	278,919	228,868,564	212,786	246,810,742	229,467	277,153,628	257,678
5	1,388,813	694,407	300,000,000	694,407	213,895,854	495,102	235,057,850	544,086	271,719,243	628,945
6	2,933,425	1,466,713	300,000,000	1,466,713	199,902,667	977,332	223,864,619	1,094,483	266,391,415	1,302,399
7	6,201,132	3,100,566	300,000,000	3,100,566	186,824,923	1,930,877	213,204,399	2,203,514	261,168,054	2,699,229
8	13,097,914	6,548,957	300,000,000	6,548,957	174,602,731	3,811,553	203,051,809	4,432,592	256,047,111	5,589,472
9	27,665,168	13,832,584	300,000,000	13,832,584	163,180,123	7,524,009	193,382,675	8,916,607	251,026,580	11,574,488
10	58,433,848	29,216,924	300,000,000	29,216,924	152,504,788	14,852,403	184,173,976	17,936,657	246,104,490	23,968,054
11	123,422,875	0		123,422,875		58,637,319		72,162,799		99,264,457
12	260,691,475	0		260,691,475		115,750,133		145,162,768		205,553,449
13	550,634,425	0		550,634,425		228,493,710		292,013,192		425,658,320
14	1,163,044,018	0		1,163,044,018		451,048,522		587,416,261		881,442,014
15	2,456,604,063	0		2,456,604,063		890,386,364		1,181,668,558		1,825,293,005
16	2,456,604,063	0		2,456,604,063		832,136,789		1,125,398,626		1,789,502,946
17	2,456,604,063	0		2,456,604,063		777,697,934		1,071,808,215		1,754,414,653
18	2,456,604,063	0		2,456,604,063		726,820,499		1,020,769,729		1,720,014,365
19	2,456,604,063	0		2,456,604,063		679,271,494		972,161,647		1,686,288,593

20	2,456,604,063	0		2,456,604,063		634,833,172		925,868,235		1,653,224,111
Total	**16,948,214,599**	**55,398,714**	**3,000,000,000**	**16,892,815,885**	**2,107,074,462**	**5,425,099,741**	**2,316,520,479**	**7,430,017,594**	**2,694,775,502**	**12,086,923,388**

Year	Total cost of RIFA uncontrolled	RIFA damage costs with eradication program	Cost of eradication	Avoided cost/Benefit of eradication	Cost of eradication with 7% discount rate	Avoided cost/Benefit of eradication with 7% discount rate	Cost of eradication with 5% discount rate	Avoided cost/Benefit of eradication with 5% discount rate	Cost of eradication with 2% discount rate	Avoided cost/Benefit of eradication with 2% discount rate
1	60,604	30,302	200,000,000	30,302	186,915,888	28,320	190,476,190	28,859	196,078,431	29,708
2	147,384	73,692	200,000,000	73,692	174,687,746	64,365	181,405,896	66,841	192,233,756	70,830
3	311,302	155,651	200,000,000	155,651	163,259,575	127,058	172,767,520	134,457	188,464,467	146,673
4	557,838	278,919	200,000,000	278,919	152,579,042	212,786	164,540,495	229,467	184,769,085	257,678
5	1,388,813	694,407	200,000,000	694,407	142,597,236	495,102	156,705,233	544,086	181,146,162	628,945
6	2,933,425	1,466,713	200,000,000	1,466,713	133,268,445	977,332	149,243,079	1,094,483	177,594,276	1,302,399
7	6,201,132	3,100,566	200,000,000	3,100,566	124,549,948	1,930,877	142,136,266	2,203,514	174,112,036	2,699,229
8	13,097,914	6,548,957	200,000,000	6,548,957	116,401,821	3,811,553	135,367,872	4,432,592	170,698,074	5,589,472
9	27,665,168	13,832,584	200,000,000	13,832,584	108,786,749	7,524,009	128,921,783	8,916,607	167,351,053	11,574,488
10	58,433,848	29,216,924	200,000,000	29,216,924	101,669,858	14,852,403	122,782,651	17,936,657	164,069,660	23,968,054
11	123,422,875	0		123,422,875		58,637,319		72,162,799		99,264,457
12	260,691,475	0		260,691,475		115,750,133		145,162,768		205,553,449
13	550,634,425	0		550,634,425		228,493,710		292,013,192		425,658,320
14	1,163,044,018	0		1,163,044,018		451,048,522		587,416,261		881,442,014
15	2,456,604,063	0		2,456,604,063		890,386,364		1,181,668,558		1,825,293,005
16	2,456,604,063	0		2,456,604,063		832,136,789		1,125,398,626		1,789,502,946
17	2,456,604,063	0		2,456,604,063		777,697,934		1,071,808,215		1,754,414,653
18	2,456,604,063	0		2,456,604,063		726,820,499		1,020,769,729		1,720,014,365
19	2,456,604,063	0		2,456,604,063		679,271,494		972,161,647		1,686,288,593
20	2,456,604,063	0		2,456,604,063		634,833,172		925,868,235		1,653,224,111
Total	**16,948,214,599**	**55,398,714**	**2,000,000,000**	**16,892,815,885**	**1,404,716,308**	**5,425,099,741**	**1,544,346,986**	**7,430,017,594**	**1,796,517,001**	**12,086,923,388**

48km per year spread model

Year	Total cost of RIFA uncontrolled	RIFA damage costs with eradication program	Cost of eradication	Avoided cost/Benefit of eradication	Cost of eradication with 7% discount rate	Avoided cost/Benefit of eradication with 7% discount rate	Cost of eradication with 5% discount rate	Avoided cost/Benefit of eradication with 5% discount rate	Cost of eradication with 2% discount rate	Avoided cost/Benefit of eradication with 2% discount rate
1	60,591	30,296	300,000,000	30,296	280,373,832	28,314	285,714,286	28,853	294,117,647	29,701
2	182,924	91,462	300,000,000	91,462	262,031,618	79,886	272,108,844	82,959	288,350,634	87,910
3	386,367	193,184	300,000,000	193,184	244,889,363	157,695	259,151,280	166,879	282,696,700	182,041
4	850,571	425,286	300,000,000	425,286	228,868,564	324,448	246,810,742	349,883	277,153,628	392,898
5	1,834,510	917,255	300,000,000	917,255	213,895,854	653,990	235,057,850	718,693	271,719,243	830,786
6	3,874,816	1,937,408	300,000,000	1,937,408	199,902,667	1,290,977	223,864,619	1,445,724	266,391,415	1,720,363
7	8,184,315	4,092,158	300,000,000	4,092,158	186,824,923	2,548,390	213,204,399	2,908,220	261,168,054	3,562,469
8	17,307,786	8,653,893	300,000,000	8,653,893	174,602,731	5,036,645	203,051,809	5,857,295	256,047,111	7,386,014
9	36,595,029	18,297,515	300,000,000	18,297,515	163,180,123	9,952,636	193,382,675	11,794,741	251,026,580	15,310,542
10	77,295,333	38,647,667	300,000,000	38,647,667	152,504,788	19,646,514	184,173,976	23,726,315	246,104,490	31,704,548
11	163,278,562	0		163,278,562		77,572,469		95,465,594		131,318,912
12	345,385,939	0		345,385,939		153,355,487		192,323,815		272,334,456
13	733,974,107	0		733,974,107		304,573,160		389,242,140		567,385,857
14	1,550,297,194	0		1,550,297,194		601,231,981		783,005,430		1,174,931,524
15	3,274,517,170	0		3,274,517,170		1,186,835,715		1,575,098,747		2,433,014,491
16	3,274,517,170	0		3,274,517,170		1,109,192,257		1,500,094,045		2,385,308,324
17	3,274,517,170	0		3,274,517,170		1,036,628,277		1,428,660,995		2,338,537,573
18	3,274,517,170	0		3,274,517,170		968,811,474		1,360,629,519		2,292,683,895
19	3,274,517,170	0		3,274,517,170		905,431,284		1,295,837,637		2,247,729,309
20	3,274,517,170	0		3,274,517,170		846,197,462		1,234,131,083		2,203,656,185
Total	**22,586,611,064**	**73,286,121**	**3,000,000,000**	**22,513,324,943**	**2,107,074,462**	**7,229,549,059**	**2,316,520,479**	**9,901,568,565**	**2,694,775,502**	**16,108,107,800**

Year	Total cost of RIFA uncontrolled	RIFA damage costs with eradication program	Cost of eradication	Avoided cost/Benefit of eradication	Cost of eradication with 7% discount rate	Avoided cost/Benefit of eradication with 7% discount rate	Cost of eradication with 5% discount rate	Avoided cost/Benefit of eradication with 5% discount rate	Cost of eradication with 2% discount rate	Avoided cost/Benefit of eradication with 2% discount rate
1	60,591	30,296	200,000,000	30,296	186,915,888	28,314	190,476,190	28,853	196,078,431	29,701
2	182,924	91,462	200,000,000	91,462	174,687,746	79,886	181,405,896	82,959	192,233,756	87,910
3	386,367	193,184	200,000,000	193,184	163,259,575	157,695	172,767,520	166,879	188,464,467	182,041
4	850,571	425,286	200,000,000	425,286	152,579,042	324,448	164,540,495	349,883	184,769,085	392,898
5	1,834,510	917,255	200,000,000	917,255	142,597,236	653,990	156,705,233	718,693	181,146,162	830,786
6	3,874,816	1,937,408	200,000,000	1,937,408	133,268,445	1,290,977	149,243,079	1,445,724	177,594,276	1,720,363
7	8,184,315	4,092,158	200,000,000	4,092,158	124,549,948	2,548,390	142,136,266	2,908,220	174,112,036	3,562,469
8	17,307,786	8,653,893	200,000,000	8,653,893	116,401,821	5,036,645	135,367,872	5,857,295	170,698,074	7,386,014
9	36,595,029	18,297,515	200,000,000	18,297,515	108,786,749	9,952,636	128,921,783	11,794,741	167,351,053	15,310,542
10	77,295,333	38,647,667	200,000,000	38,647,667	101,669,858	19,646,514	122,782,651	23,726,315	164,069,660	31,704,548
11	163,278,562	0		163,278,562		77,572,469		95,465,594		131,318,912
12	345,385,939	0		345,385,939		153,355,487		192,323,815		272,334,456
13	733,974,107	0		733,974,107		304,573,160		389,242,140		567,385,857
14	1,550,297,194	0		1,550,297,194		601,231,981		783,005,430		1,174,931,524
15	3,274,517,170	0		3,274,517,170		1,186,835,715		1,575,098,747		2,433,014,491
16	3,274,517,170	0		3,274,517,170		1,109,192,257		1,500,094,045		2,385,308,324
17	3,274,517,170	0		3,274,517,170		1,036,628,277		1,428,660,995		2,338,537,573
18	3,274,517,170	0		3,274,517,170		968,811,474		1,360,629,519		2,292,683,895
19	3,274,517,170	0		3,274,517,170		905,431,284		1,295,837,637		2,247,729,309
20	3,274,517,170	0		3,274,517,170		846,197,462		1,234,131,083		2,203,656,185
Total	**22,586,611,064**	**73,286,121**	**2,000,000,000**	**22,513,324,943**	**1,404,716,308**	**7,229,549,059**	**1,544,346,986**	**9,901,568,565**	**1,796,517,001**	**16,108,107,800**

Summary of CBA results

	$300 million per year program				$200 per year program			
Discount rate	5km per year spread model		48km per year spread model		5km per year spread model		48km per year spread model	
	Net present value ($m)	Benefit-cost ratio	Net present value ($m)	Benefit-cost ratio	Net present value($m)	Benefit-cost ratio	Net present value($m)	Benefit-cost ratio
7%	3,318.03	2.57	5,122.47	3.43	4,020.38	3.86	5,824.83	5.15
5%	5,113.50	3.21	7,585.05	4.27	5,885.67	4.81	8,357.22	6.41
2%	9,392.15	4.49	13,413.33	5.98	10,290.41	6.73	14,311.59	8.97