Manaaki Whenua
Landcare Research

Research needs for effective wallaby management in New Zealand

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Management of Bennett's wallaby – having confidence in no detections

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Acknowledgements

- Co-authors: Dean Anderson, Rachelle Binny, Simon Howard, Cecilia Latham and Bruce Warburton
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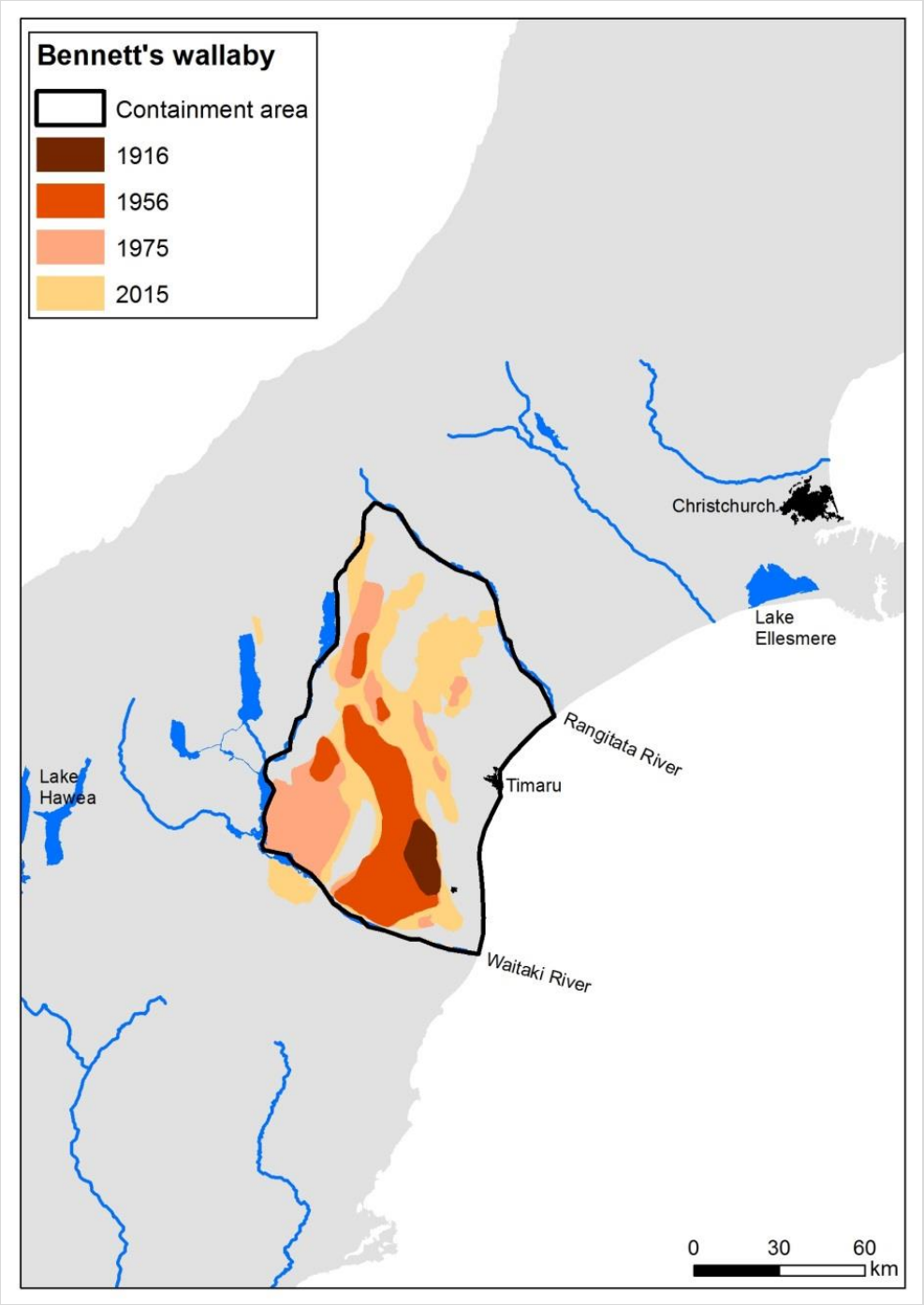
  - Ross Chilton and Lloyd Brown – ground surveys
  - Grant Halverson and Jordan Munn – thermal cameras
  - Brent Glentworth – logistical support and feedback

Background

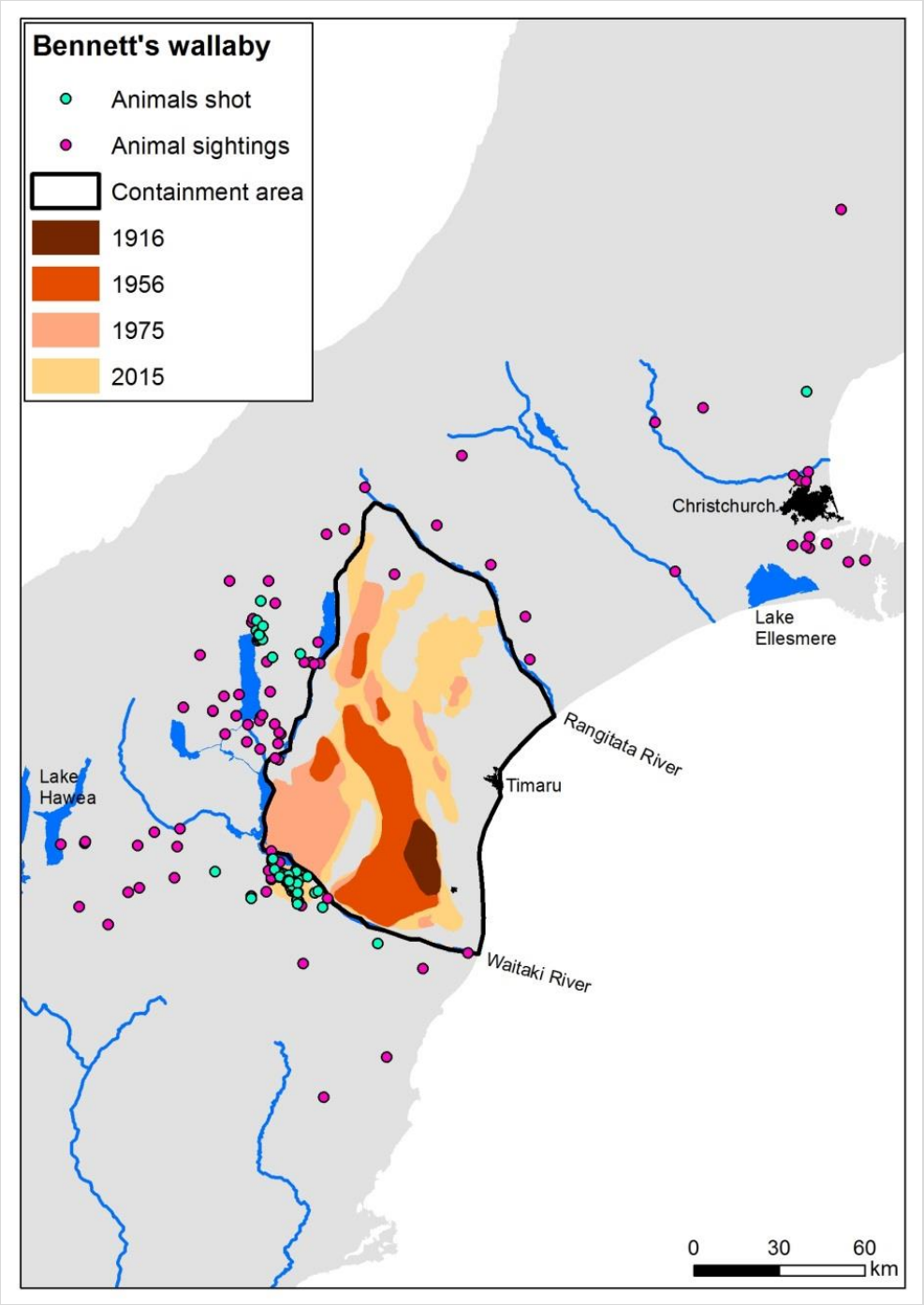
- Research objectives are relevant to all species of wallaby in NZ, but our research focused on Bennett's wallaby

- Liberated in Hunters Hills, SI, in 1874
- Established and became invasive
- Unwanted impacts in production landscapes and on native vegetation



Distribution

- 2015 core range: 5,300 km^2



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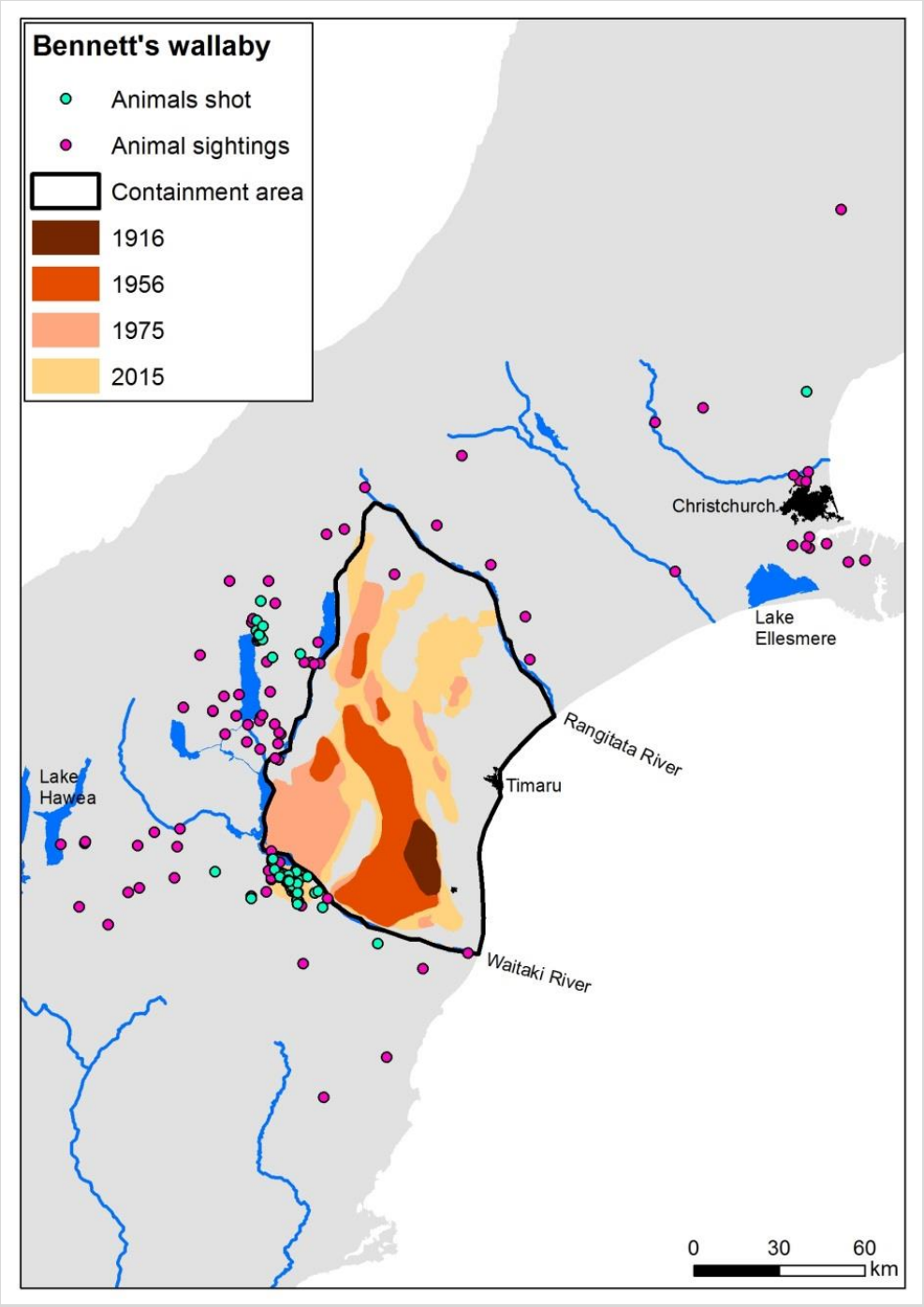
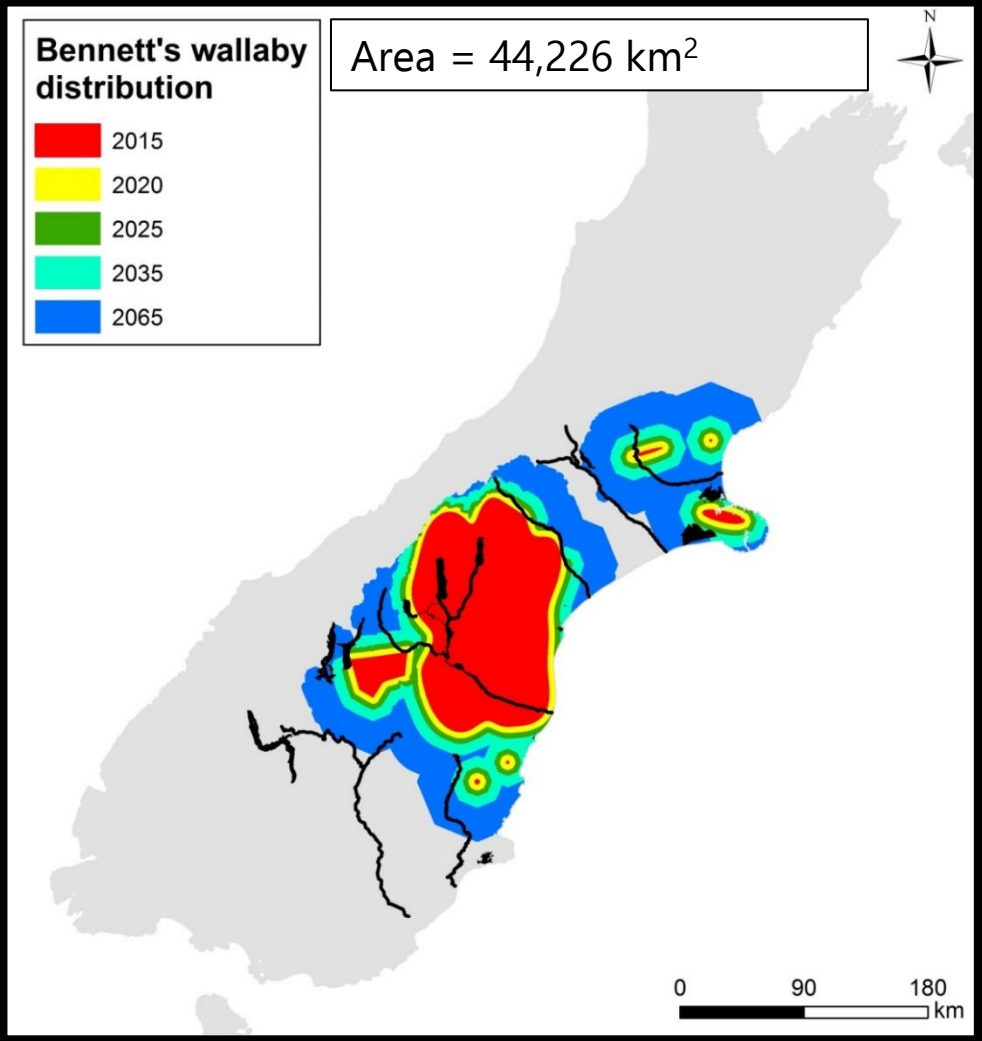
- Range incl. low density peripheral populations: 14,000 km^2



Distribution

- 2015 core range: 5,300 km^2
- Range incl. low density peripheral populations: 14,000 km^2
- Populations outside the Containment Area are key starting points for eradication

Predicted distribution in 50 years
(without intensive control)



Objectives

- The National Wallaby Eradication Programme
  - Strategic objective: eradication of all species of wallaby from NZ

- This objective requires a tool to guide how much survey effort is needed to have confidence that a targeted wallaby population has been eradicated

- What do I mean by this?
  - If one or more wallabies are seen after an eradication attempt, eradication was clearly not successful
  - But what if the target area is surveyed and no wallabies are seen?
  - Is it because there are no wallabies present, or wallabies are present but were not seen?

Objectives

- Subtitle: Management of Bennett's wallaby – having confidence in no detections

- Having confidence that no detections equals no wallabies is critical for eradication, i.e., stopping removal too early will allow survivors to recover and stopping too late will waste funding

Objectives

- Determine detection probabilities and surveillance sensitivity for a suite of survey methods for proof of eradication modelling

- Two critical points:
    1. We did not compare the relative effectiveness of different detection methods for sustained control (or kill rates achieved, etc)
    2. We assessed detection probabilities, not detection rates

Terminology

- Detection rates enable us to determine how well one survey method performs compared with another method, or over time
  - It does not inform us about number of animals not detected
  - However, if a method has a high detection rate, its detection probability will, on average, also be high

- The probability of detection is the probability of a survey method detecting a specific individual given that the individual is present in the detection range at a specified time

- The surveillance system sensitivity is the probability that multiple survey devices or search paths will detect a specific individual given that it is present anywhere within the total area of interest

Methodology

- Determined detection probabilities for:
  - Ground hunter with dogs
  - Helicopter observers
  - Helicopter with a thermal imaging camera
  - Camera traps

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- Used detection probabilities and search effort to estimate surveillance sensitivity for each survey method and used this information to develop a proof of eradication model

Methodology

How do we estimate detection probabilities?

1 - We need to know how many animals were in the area

2 - AND we need to know how many of these we detected

- This is critical as it gives us our detection probability for each survey method
- Estimating N is difficult in wild populations

GPS collars

- Our approach was to capture wallabies and deploy a GPS collar on them that took a fix at 5 s intervals
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- We knew how many animals ‘could’ have been seen when the helicopter flew by, or the ground-hunter walked by, and we could compare this with how many were actually seen for each survey method

Results

- 38 wallabies collared; 30 provided usable GPS data

Method	Collared wallabies		
	No. seen	No. available to be seen	Avg. prob. detection
Ground-hunter	34	59	0.56
Aerial observer	25	159	0.16
Thermal imaging	12	54	0.14

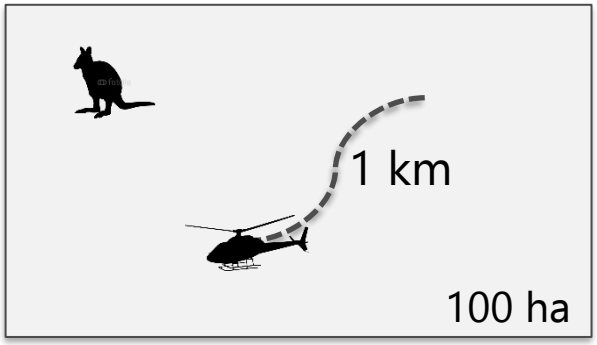
- Probability of detection is calculated for the number of collared individuals that were available to be seen. For example:
  - Some collared wallabies moved out of the study area
  - Not all methods have the same field of view

Results

Method	Prob. Detection	All wallabies	
		Total wallabies seen	No. seen per km surveyed
Ground-hunter	0.56	394	7.8
Aerial observer	0.16	266	0.7
Thermal imaging	0.14	342	0.9

Surveillance sensitivity (SSe) for mobile methods

- SSe = detection probabilities & search effort (coverage)
- Varies between 0 (insensitive) and 1 (perfect sensitivity)
- Standardised for a 1km search transect in a 100ha survey area



Method	SSe
Ground hunter	0.172
Aerial observer	0.042
Thermal imaging	0.022

SSe for each survey method and probability of wallaby absence

- For a hypothetical 100 ha survey area, with **NO** wallabies detected

Method	Effort of single survey	SSe (1 survey)	Effort required for 95% Prob. absence
Ground hunter	Full coverage (~5 transects)	0.45	5 surveys
Aerial observer	Full coverage (~4 transects)	0.13	21 surveys
Thermal imaging	Full coverage (~10 transects)	0.20	14 surveys
Camera traps	16 cameras; 300m × 300m spacing; 80 nights	0.82	160 nights

Comparative costs (based on our work)

	Thermal	Aerial Observer	Ground hunter with Dogs	Camera
Speed	60	60	4	–
Swath	100	300	200	–
$/hr	1800	1800	50	50
Ha/hr	600	1800	80	6.25
$/ha	3.00	1.00	0.63	8
Surveillance sensitivity	0.20	0.13	0.45	0.82
Desired surveillance sensitivity	0.95	0.95	0.95	0.95
N. repeat surveys required	14	21	5	160
Total surveillance $/ha	**$42.00**	**$21.00**	**$3.13**	**$8.00**

Limitations

- We developed a surveillance protocol for proof of eradication modelling for Bennett's wallaby
- This model needed quantitative empirical data for each survey method

- Scientific constraints may have biased some survey methods, especially the thermal imaging camera

- We could not determine effort (swath width) for thermal if the operator 'hunted' with the camera
  - A key research need when the technology permits
- Using thermal on UAV is another research need

Summary

- Ground hunters with dogs and camera traps performed well, but are unable to cover large areas rapidly unless a very large pool of hunters / trail cameras are available
- Aerial methods were less effective and more expensive (/ ha), but will be critical for surveying large areas within required timeframes
- The methodological approach detailed here will be critical for achieving wallaby eradication
- We need better and more data for parameterising the proof of eradication model
  - Thermal imaging camera operated from a helicopter and UAV
  - Other species of wallabies