Why Fly?

How do we know that aerial firefighting operations are effective and efficient? –*Project update*

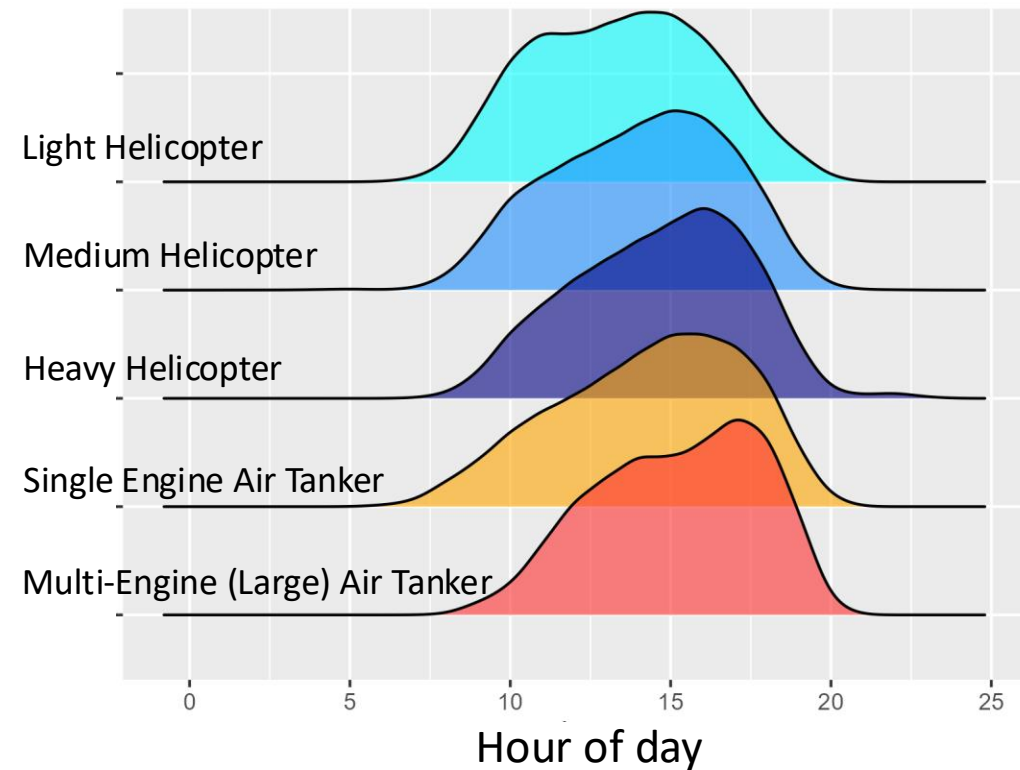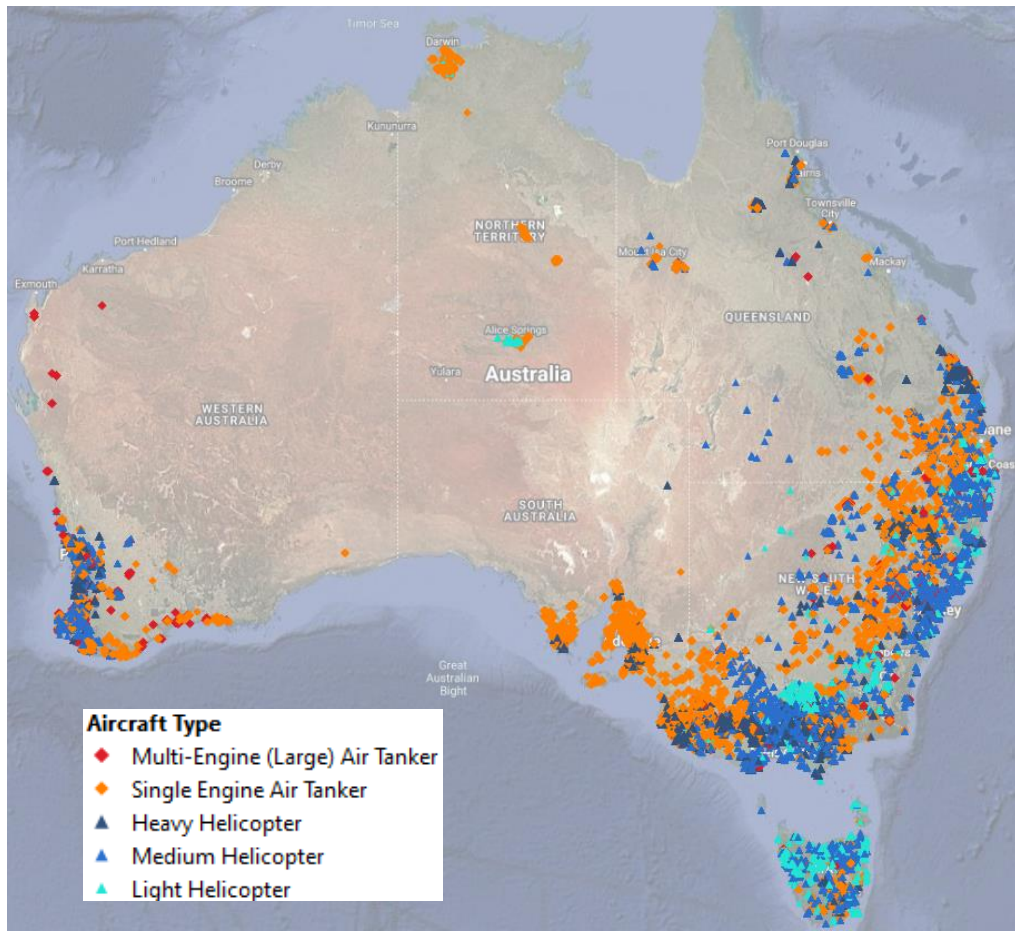**Matt Plucinski**   **Owen Price**

CSIRO   University of Wollongong

Use study

How are firebombing aircraft currently used in Australia?

Examining the conditions and objectives that different aircraft types are being used

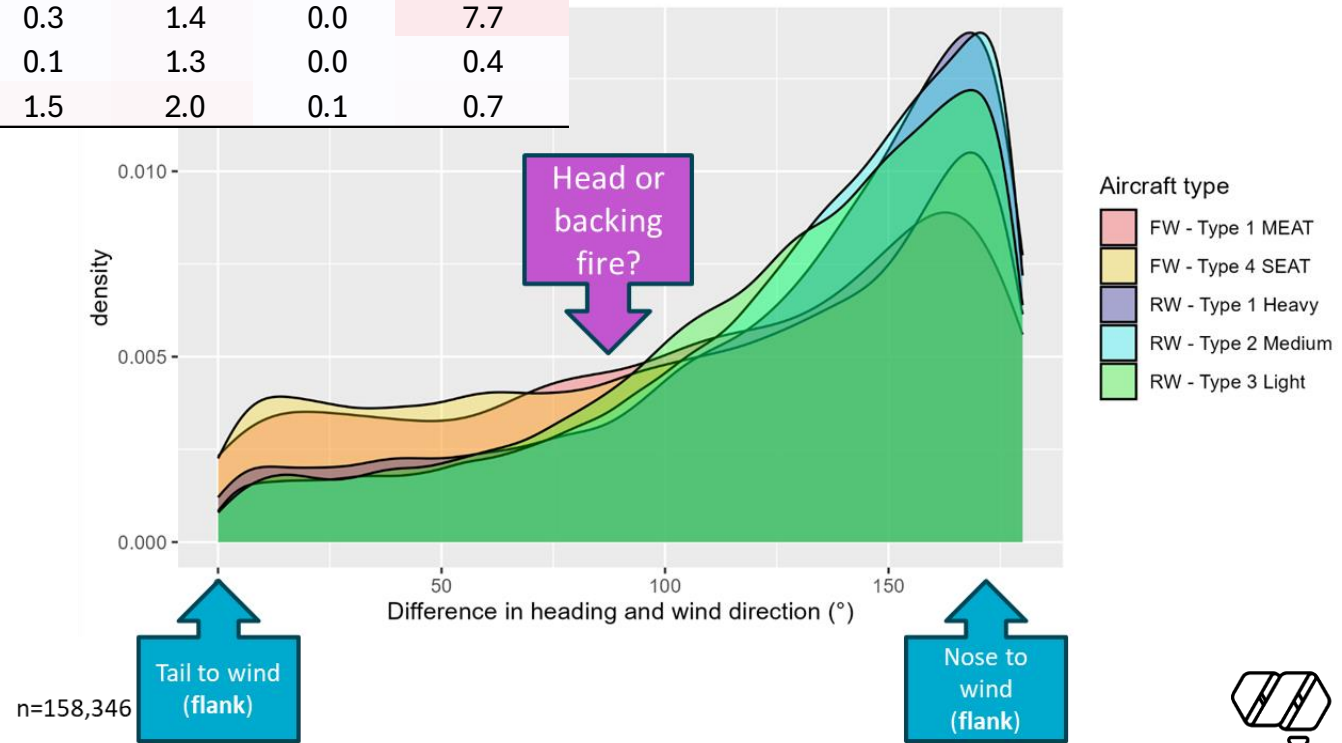# Use study

How are firebombing aircraft currently used in Australia?

Examining the conditions and objectives that different aircraft types are being used

(% for Aircraft type)	Forest	Woodland	Shrubland	Grassland	Other	Water	Interface	Built	Bareground
Multi Engine Air Tanker	50.9	19.0	2.2	21.4	1.3	0.9	2.6	0.3	1.3
Single Engine Air Tanker	54.0	15.8	1.8	21.8	1.5	0.4	2.7	0.2	1.8
Heavy helicopter	57.3	9.3	0.4	21.9	1.7	0.3	1.4	0.0	7.7
Medium helicopter	48.3	22.1	3.8	23.1	1.0	0.1	1.3	0.0	0.4
Light helicopter	36.3	23.3	3.2	29.9	2.9	1.5	2.0	0.1	0.7

(% for Aircraft type)	Water	Retardant	Foam	Gel
Multi Engine Air Tanker	22.5	72.6	0.3	4.6
Single Engine Air Tanker	43.0	7.4	28.4	21.2
Heavy helicopter	84.7	0.0	15.3	0.0
Medium helicopter	69.5	0.0	25.7	4.7
Light helicopter	96.3	0.0	3.7	0.0

Head or backing fire?

Aircraft type
- FW - Type 1 MEAT
- FW - Type 4 SEAT
- RW - Type 1 Heavy
- RW - Type 2 Medium
- RW - Type 3 Light

density

Difference in heading and wind direction (°)

Tail to wind (flank)

Nose to wind (flank)

n=158,346

Case studies

How and why are firebombing aircraft currently used in Australia?

Finer details on use and effectiveness within fires

(E.g. drop objectives, tactics, outcomes)

Building a data set from multiple incidents

2290 drops from 20 fires so far

Drop objective	FW - Type 1 MEAT	FW - Type 4 SEAT	RW - Type 1 Heavy	RW - Type 2 Medium	RW - Type 3 Light
Reduce fire intensity/flame length	0	16	59	103	0
Delay fire spread/retard growth	3	143	518	263	0
Support ignition operations	0	0	244	12	0
Point protection	2	41	345	86	0
Line fire/halt advance	23	74	31	11	0
Extinguish fire	0	0	272	4	34
Extinguish spot fire	0	0	2	3	0

Part of fire	N drops	%
Head	255	11.1
Flank	1892	82.7
Back	35	1.5
Spot	85	3.7
Internal	4	0.2
Whole fire	16	0.7

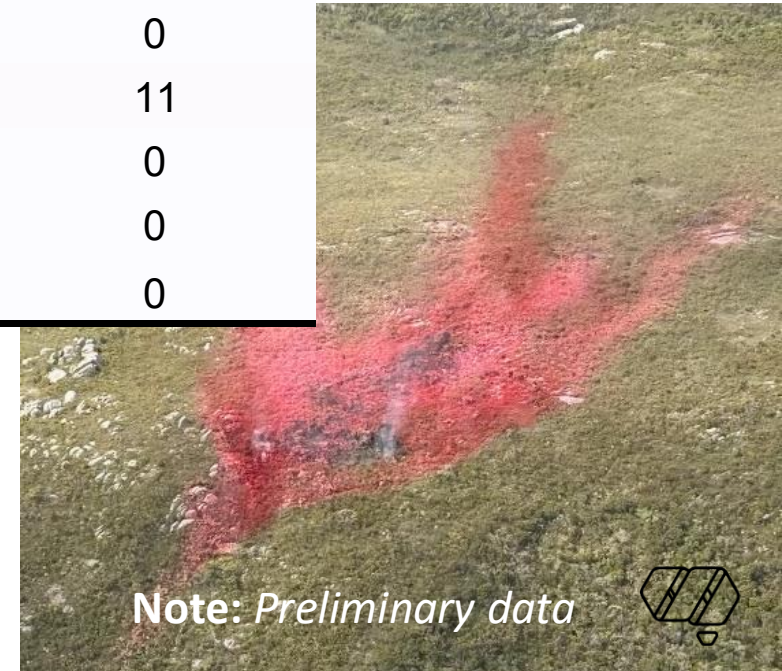**Note:** *Preliminary data*

Case studies

How and why are firebombing aircraft currently used in Australia?

Are they effective?

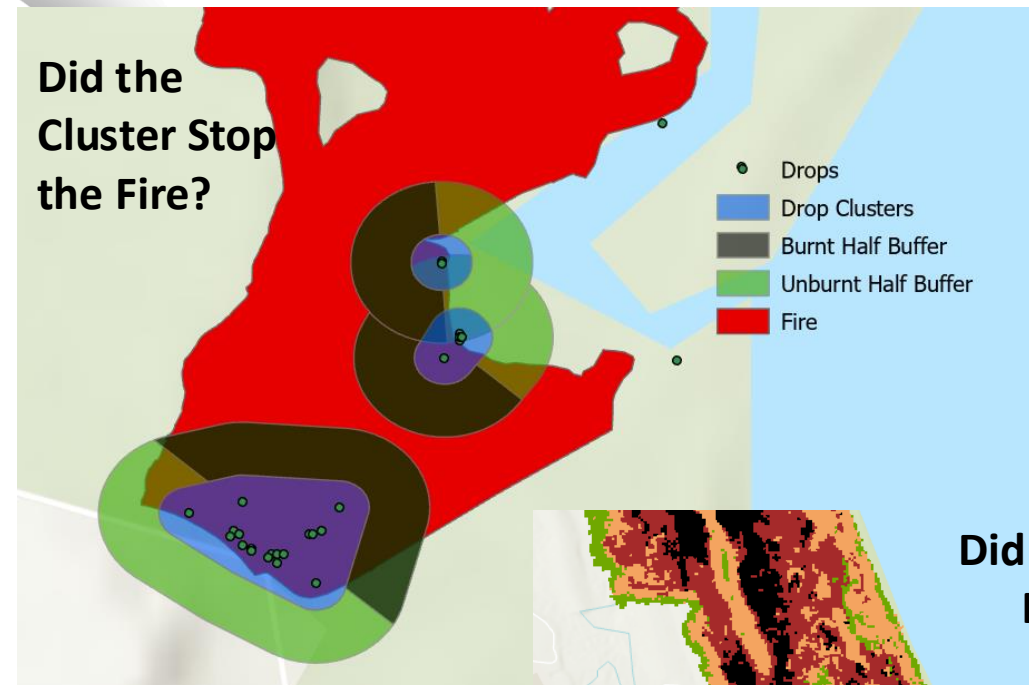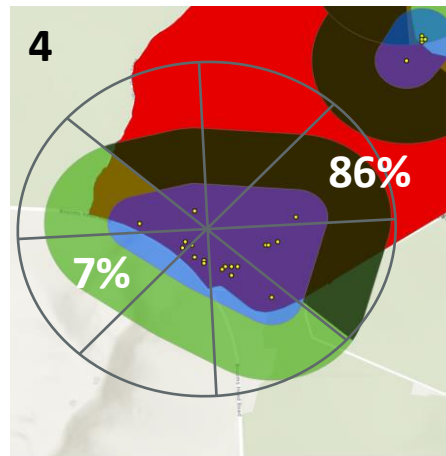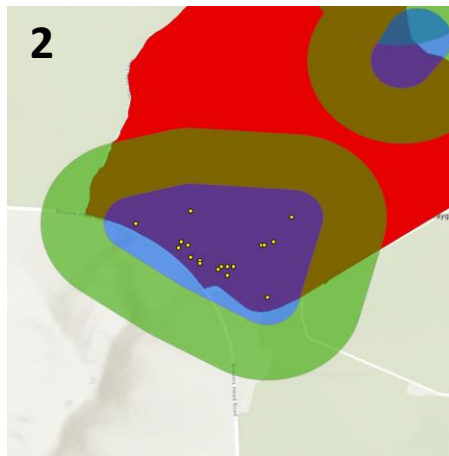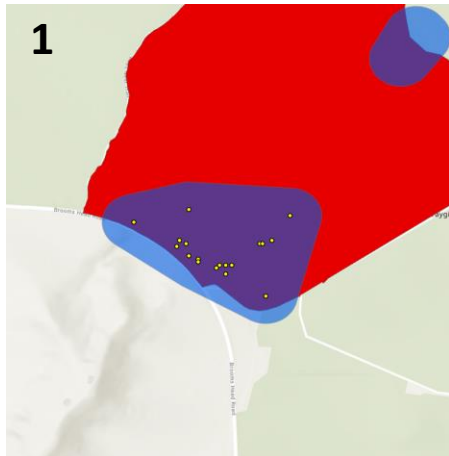| Drop objective	Contributed < objectives	Met objectives	No fire interaction
Reduce fire intensity/flame length	0	178	0
Delay fire spread/retard growth	163	764	0
Support ignition operations	0	256	0
Point protection	0	463	11
Line fire/halt advance	7	130	0
Extinguish fire	0	310	0
Extinguish spot fire	0	5	0

Note: *Preliminary data*

Cluster-based analysis

Data = Drops + Fire Boundaries

1. Create Clusters around drops

2. Buffer the cluster by 200 m

3. Divide the buffer into 8 sectors
   - Measure area burnt in each

4. Find the 'half' buffer with the highest area burnt

Did the Cluster Stop the Fire?

Drops
Drop Clusters
Burnt Half Buffer
Unburnt Half Buffer
Fire

Did the Cluster Reduce Fire Severity?

1

2

4

86%

7%
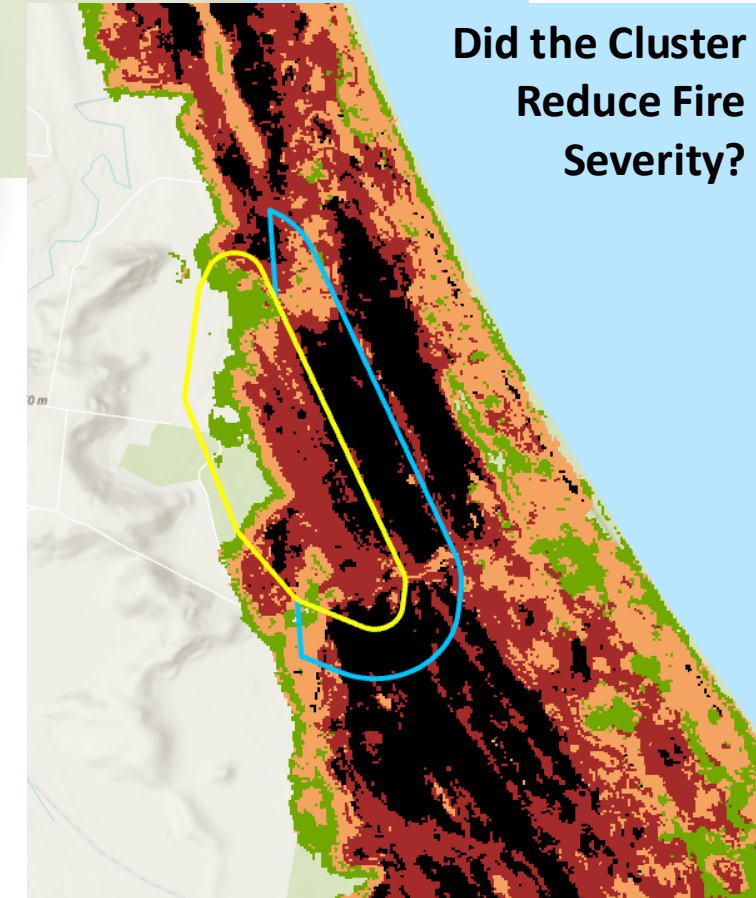
Patterns in drops

State	Cluster Count	% Found in the Fire History	% Stopped the Fire	% Needing only One Cluster	% Needing >5 Clusters
ACT	2	0	NA	100	0
NSW	4975	71	27	48	15
NT	494	0	NA	50	7
QLD	1389	34	20	47	10
SA	607	52	52	65	2
TAS	1206	67	31	60	16
VIC	1250	61	36	66	6
WA	990	75	27	62	6

5 Statistical Models

1. For all of Australia
   1. Was the cluster stopped? (n = 5400)
   2. Was only 1 cluster used? (n = 6343)

2. For NSW only
   1. Did initial attack succeed? (n = 275)
   2. Did the cluster reduced fire severity? (n = 4108)
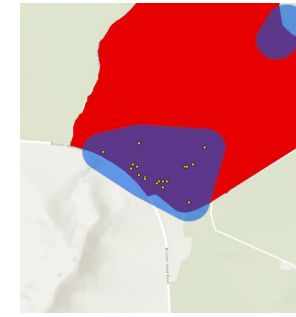   3. Did the cluster influence house loss (2019)? (n = 806)
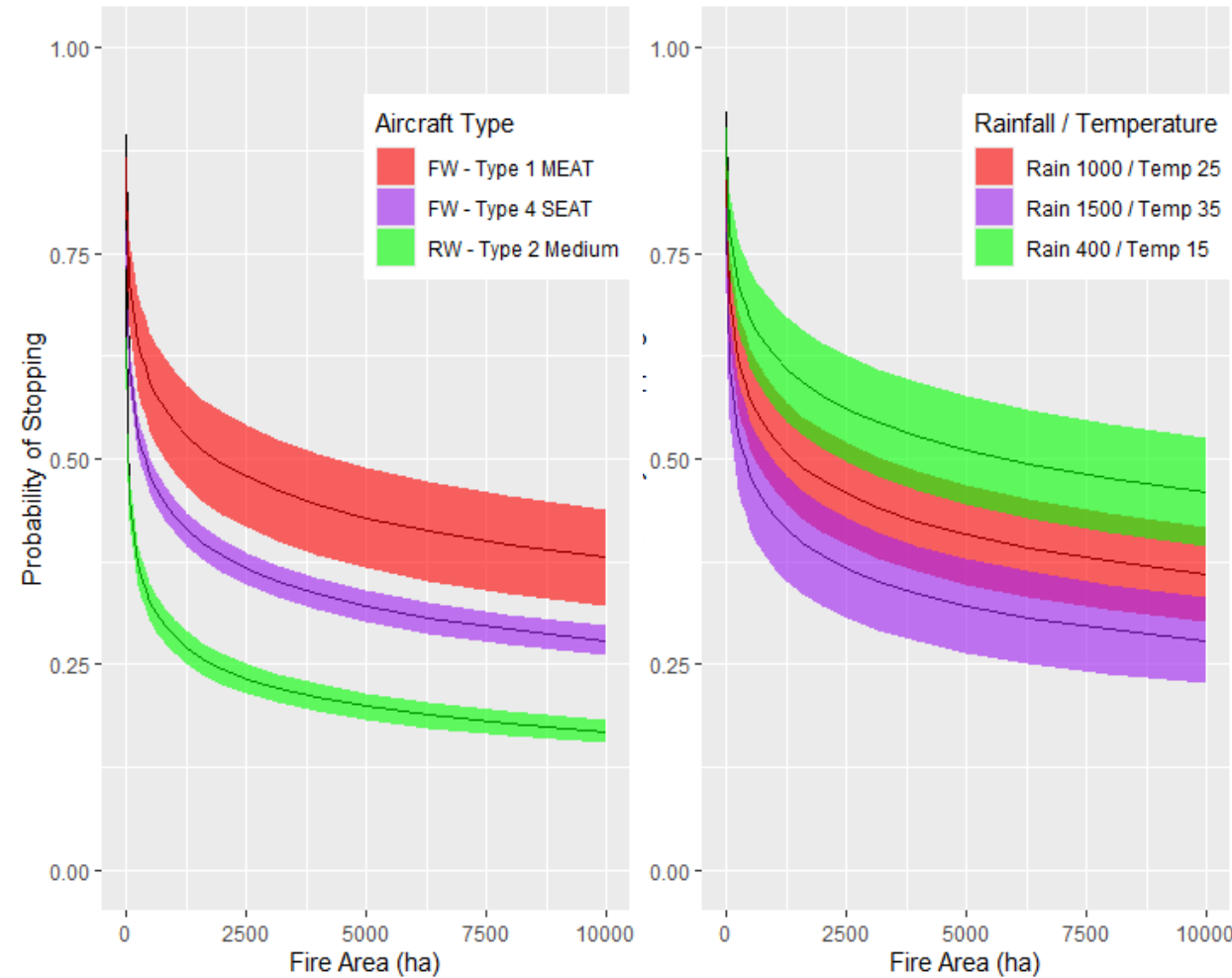
Predictors

Weather, topography, fuel, effort,

Did the fire stop in the cluster?

Binomial GLM model (n = 5400)

1. 38% of clusters stopped fire
2. Model effects of:
   1. Fire Area
   2. Rainfall
   3. Weather
   4. Topography and roads
   5. Aircraft type and drop density
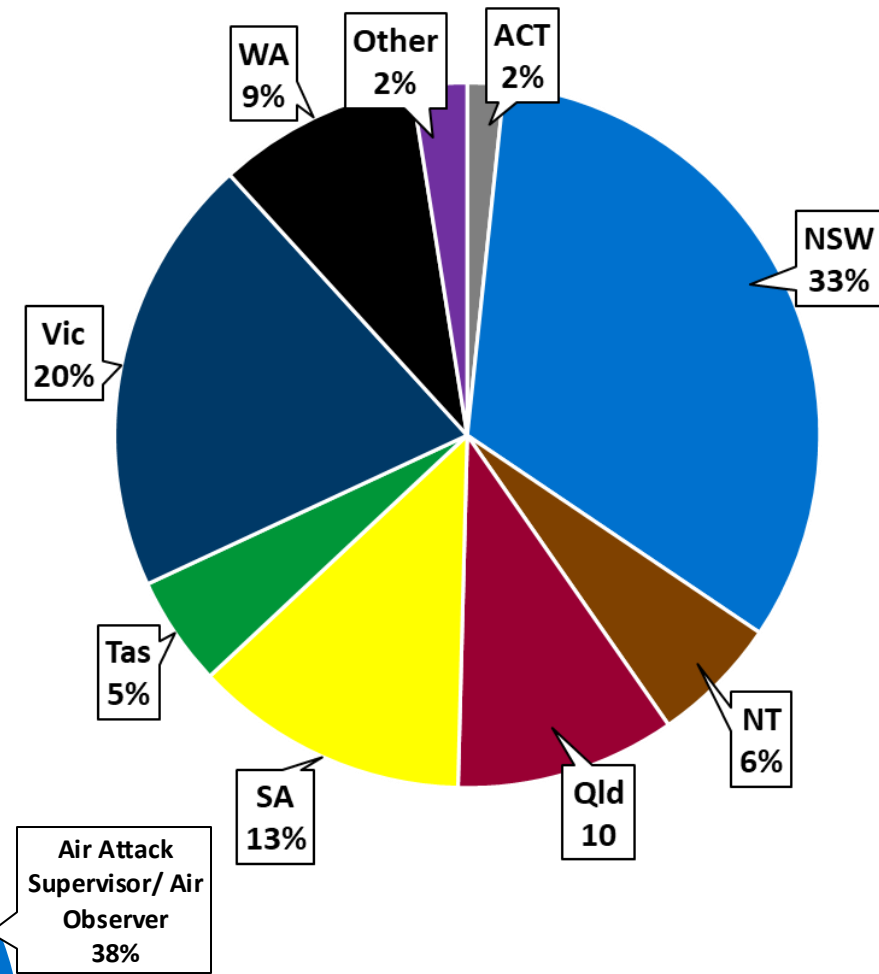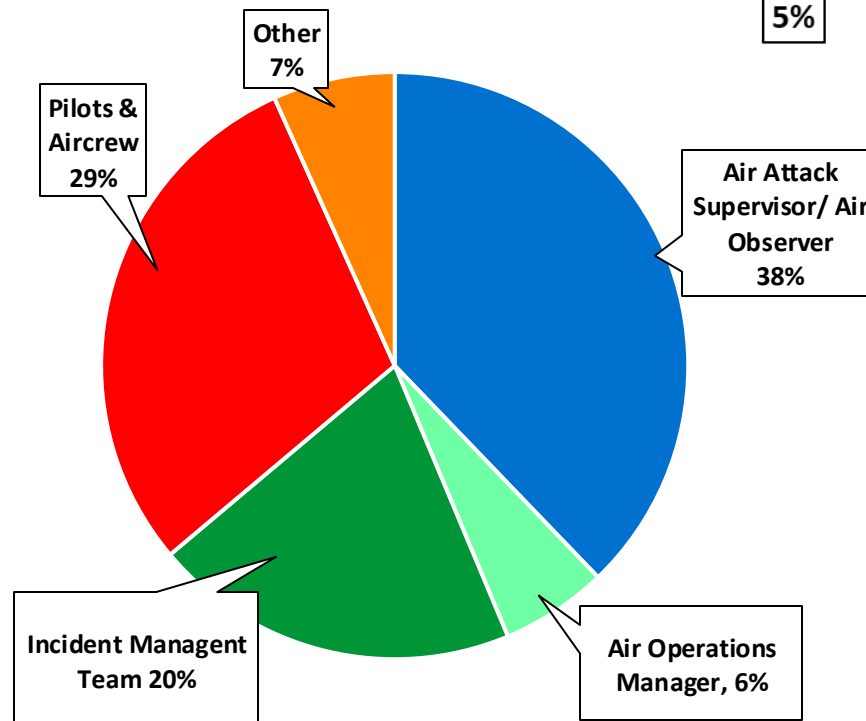
3. Model explains 9% of variation

4. Accuracy 65%

Survey

Aim: Learn how aircraft types are being used & suitability in different conditions and objectives.

Questions about objectives, tactics, use of different aircraft types

190 responses

Good representation

Conclusions

Work in progress with lots of components

Different aircraft types are used for different purposes

Most drops are used on flanks to delay fire spread and met this objective to the desired level

Initial analysis of drop clusters shows that the probability of them stopping fire progression is influenced by fire size, weather conditions and aircraft type.

Thanks to
NAFC (Deb Sparkes)
The many aviation specialists who helped
with case studies and completed the survey

Photo: Wayne Rigg AFSM CFA