



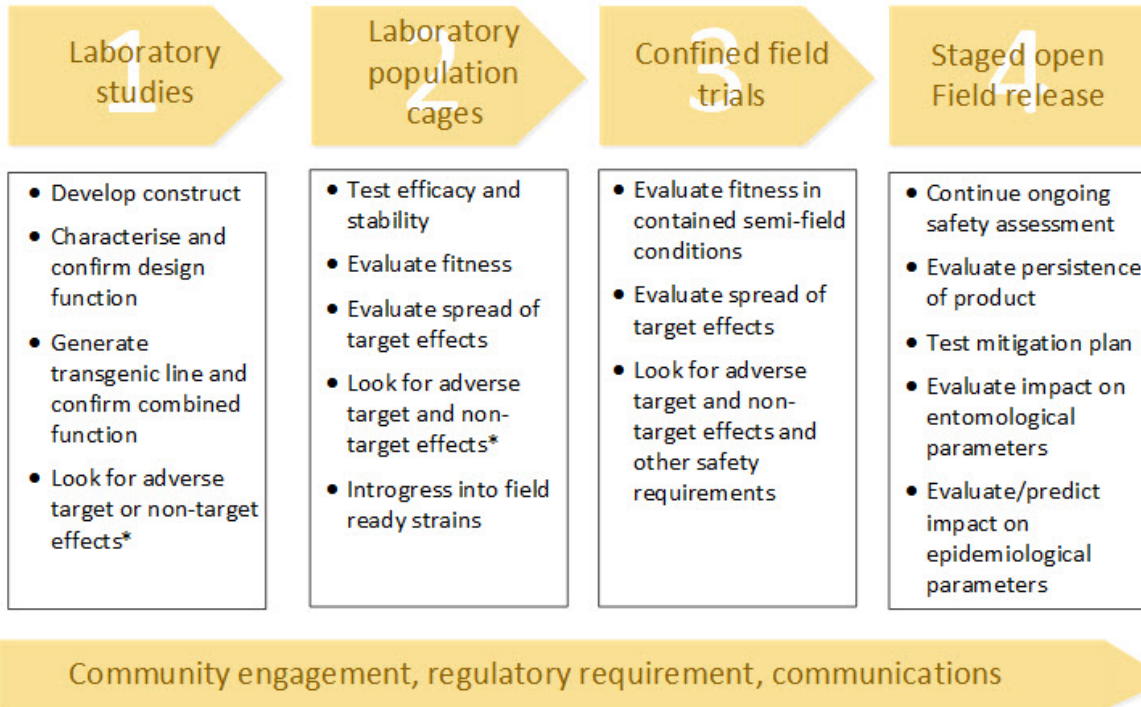
# Identifying ecological and human-health issues associated with the deliberate or accidental release of gene-drive modified organisms

Keith, Geoff, Genya (others on paper who are not here)

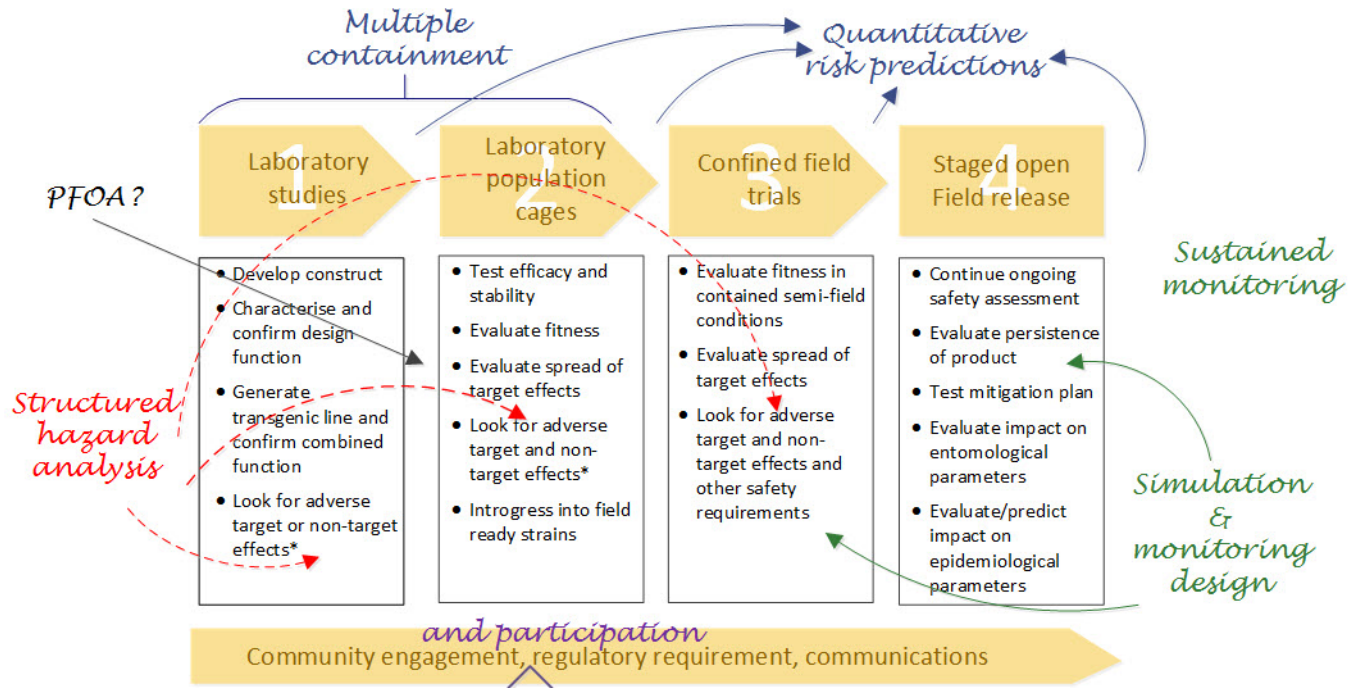
CSIRO Health and Biosecurity  
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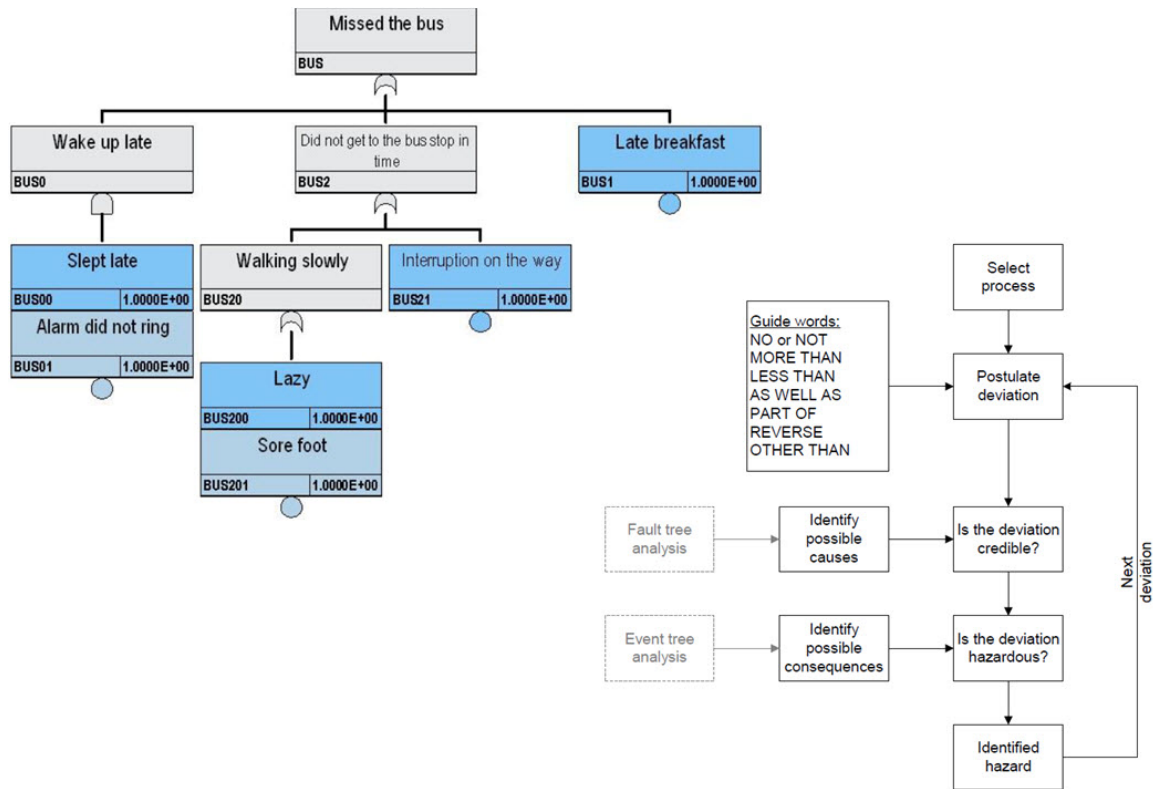
# Staged release protocol (WHO, 2009)



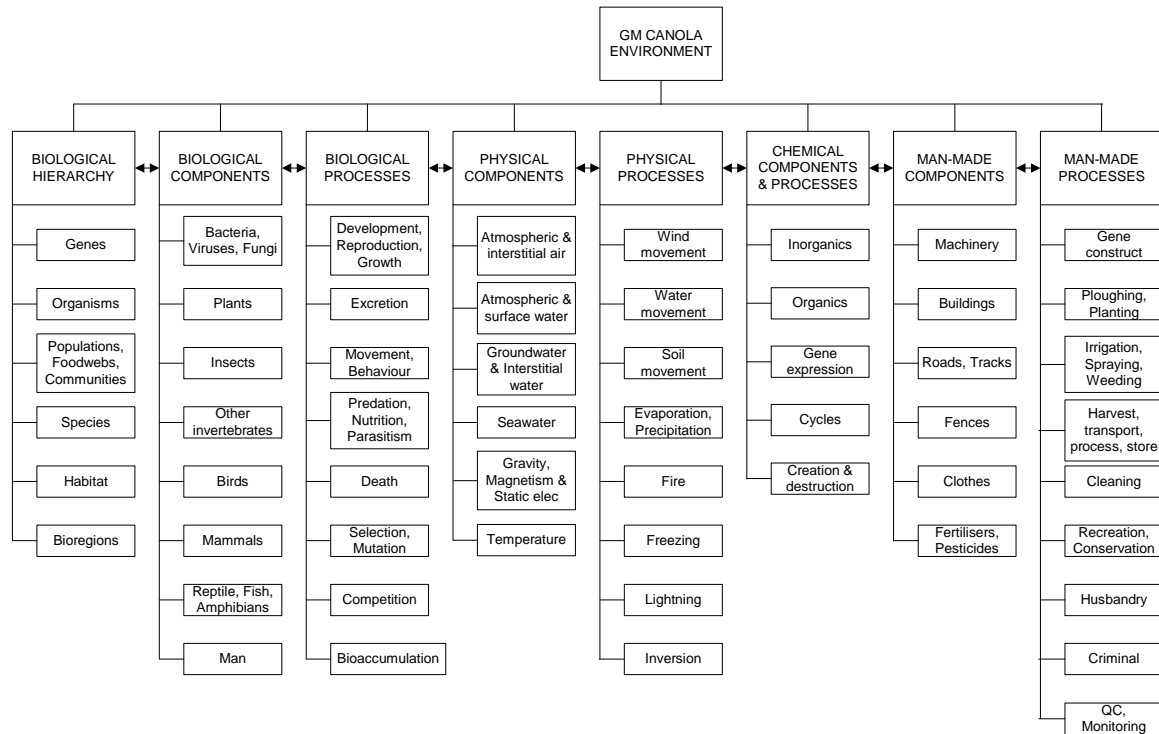
# Identifying adverse effects within a staged release protocol



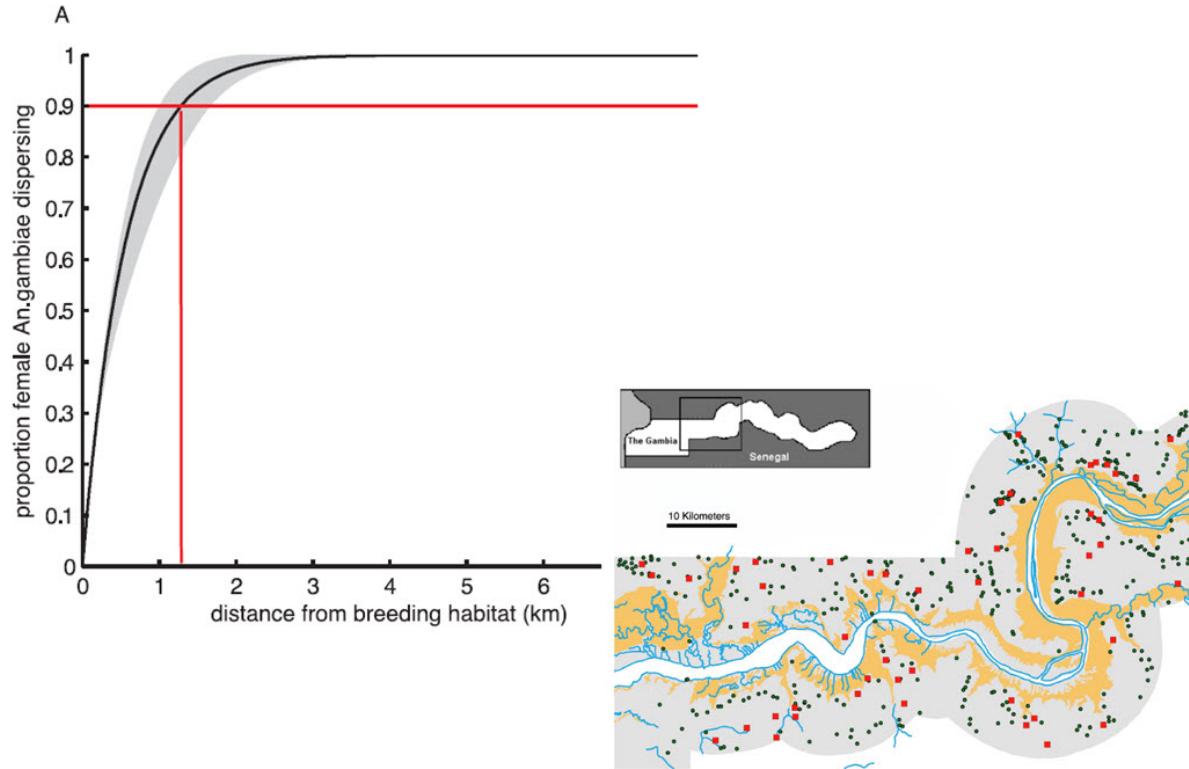
# Structured hazard analysis: FTA and HAZOP



# Structured hazard analysis: HHM (Hayes et al., 2004)



## Quantitative predictions: data sometimes (Thomas et al., 2013)



**Figure 1. Map of the study area.** Central Gambia, showing study villages (red squares), other villages (green circles), main channel of The River Gambia and tributaries (blue lines), alluvial sediment (solid yellow). The Gambia nation is shaded grey, surrounded by Senegal in white. Inset: location of the study area in The Gambia.  
doi:10.1371/journal.pone.0068679.g001

# Quantitative predictions: elicitation if no data

Keith

Data Plot Options Comments

## Pick distribution

Beta

☐ Truncate distribution?

## Enter data

### Confidence

Enter CI

### Bounds

Enter Lower Bound

Enter Upper Bound

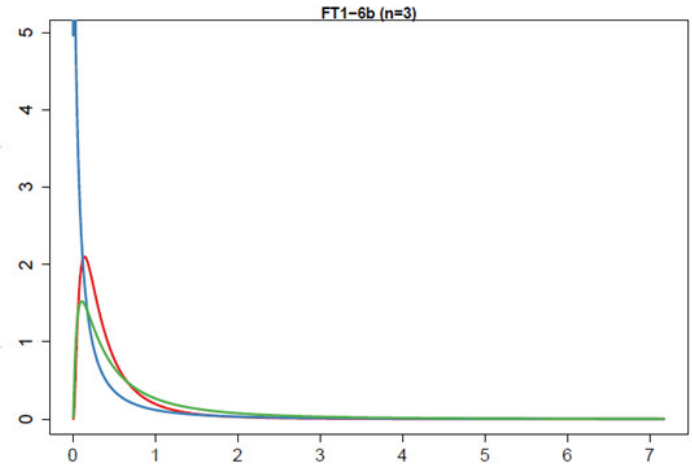
## Fitting options

### Fit with

- ☒ SB
- ☐ Median + Tertiles
- ☐ Median + Tertiles + Deciles

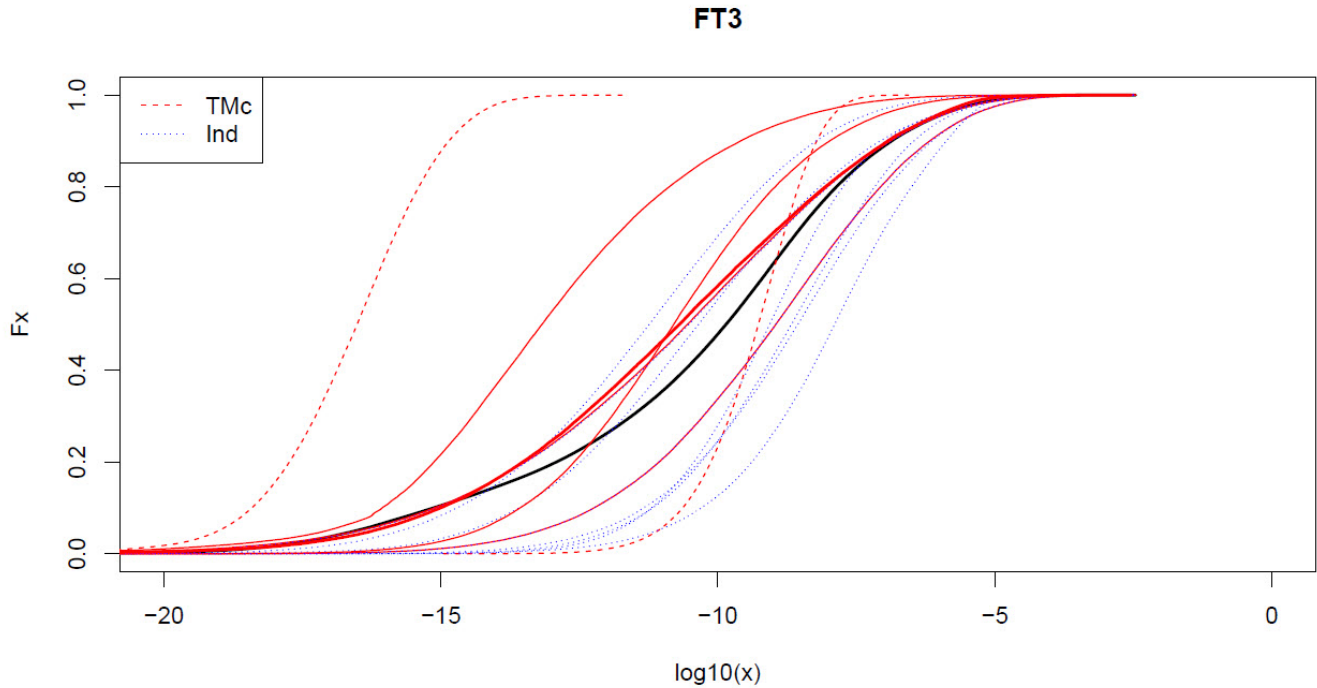
### Use criteria

- ☒ SS
- ☐ KL



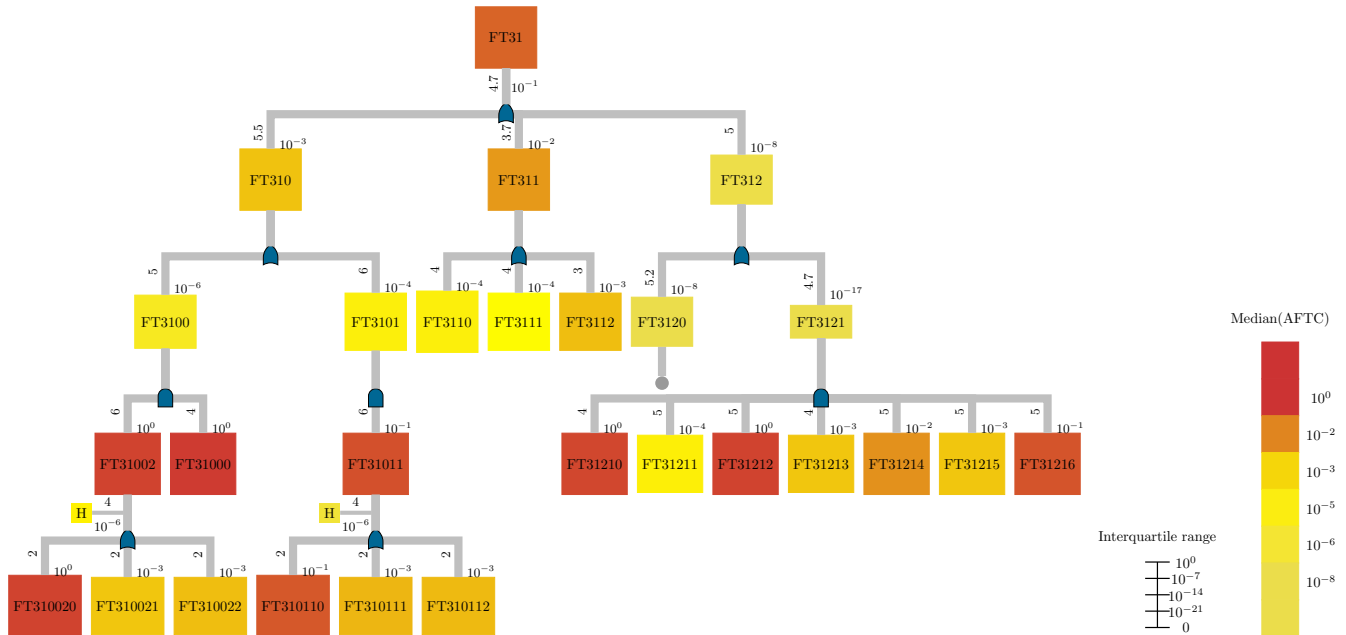
Average weekly dispersal distance (km)

## Quantitative predictions: FTA results based on elicitation

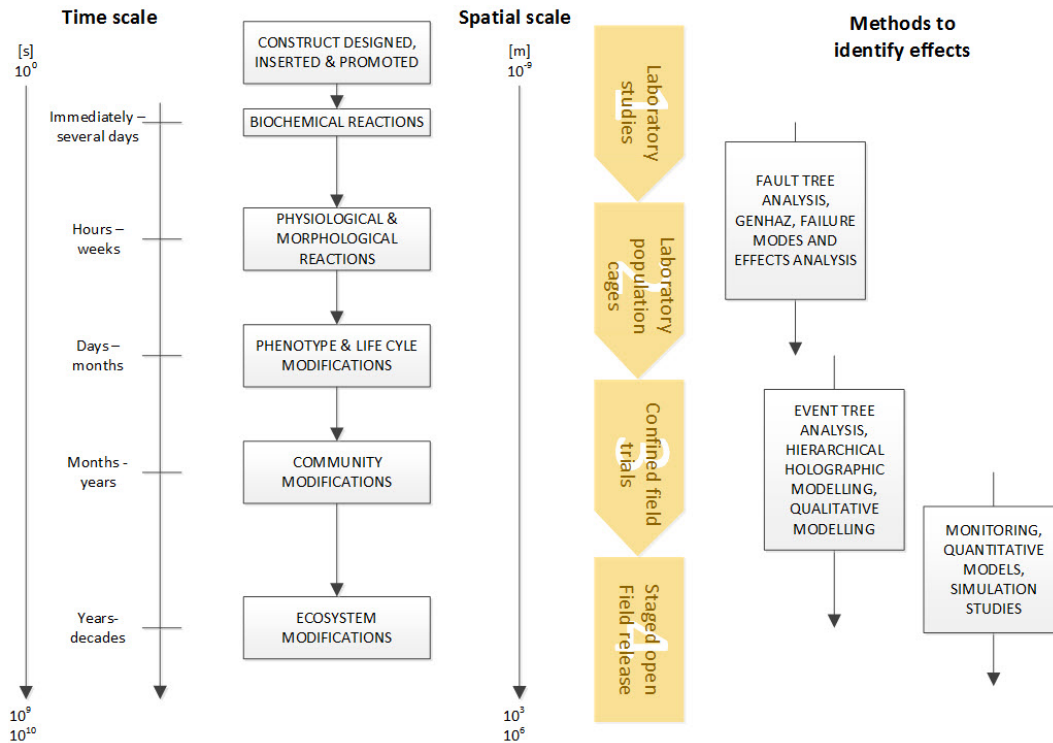




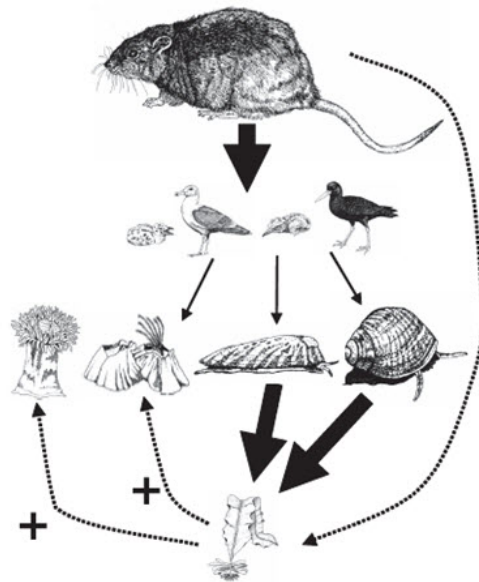
# Quantitative predictions: identifying critical steps



# Spatio-temporal challenges



## Community participation and qualitative systems modelling

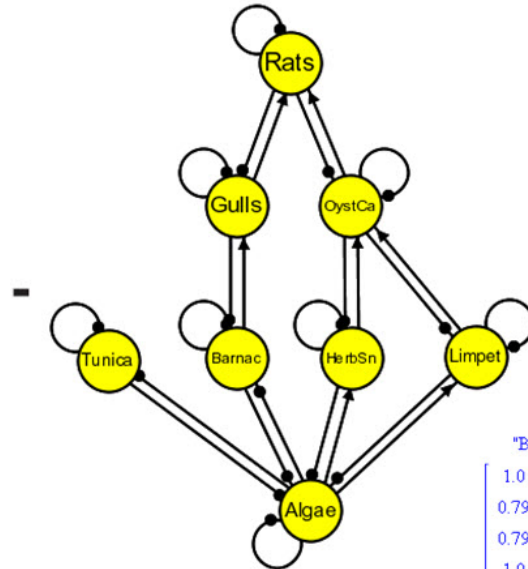


## Introduced rats indirectly change marine rocky intertidal communities from algae- to invertebrate-dominated

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Communicated by Donald Kennedy, Stanford University, Stanford, CA, January 22, 2008 (received for review September 10, 2007).



**Variables are 1: Algae, 2: Herbivorous snails, 3: Limpets, 4: Tunicates, 5: Barnacles, 6: Oyster Catchers, 7: Gulls, 8: Rats**

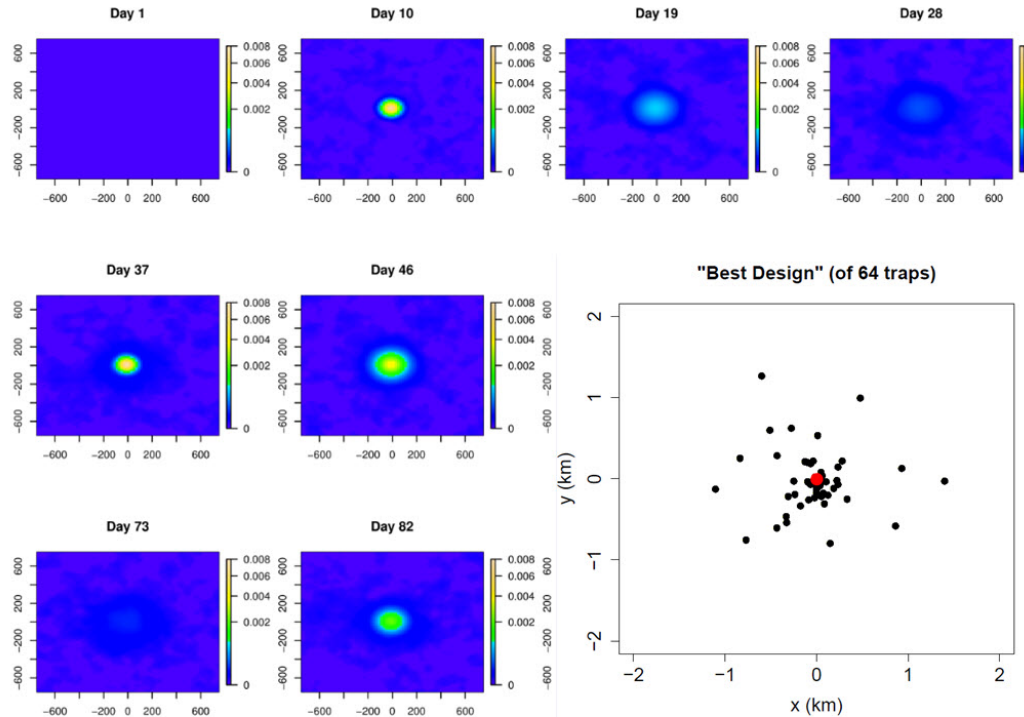
"adjoint (-A)"

$$\begin{bmatrix} 11 & -6 & -6 & -11 & -9 & 5 & 2 & -7 \\ 4 & 0 & -3 & -4 & -3 & 1 & 1 & -2 \\ 4 & -3 & 0 & -4 & -3 & 1 & 1 & -2 \\ -11 & 6 & 6 & 14 & 9 & -5 & -2 & 7 \\ -5 & 3 & 3 & 5 & 6 & -2 & -2 & 4 \\ 7 & -3 & -3 & -7 & -6 & 4 & 1 & -5 \\ -6 & 3 & 3 & 6 & 6 & -3 & 0 & 3 \\ 1 & 0 & 0 & -1 & 0 & 1 & 1 & 1 \end{bmatrix}$$

"Based on average proportion of correct sign"

1.0	0.88	0.88	1.0	1.0	0.94	0.79	1.0
0.79	0.50	0.69	0.79	0.73	0.57	0.60	0.67
0.79	0.69	0.50	0.79	0.73	0.57	0.60	0.67
1.0	0.88	0.88	0.83	1.0	0.94	0.79	1.0
0.90	0.73	0.73	0.90	0.72	0.72	0.62	0.75
1.0	0.69	0.69	1.0	0.94	0.75	0.63	0.86
1.0	0.79	0.79	1.0	0.80	0.83	0.50	0.68
0.63	0.50	0.50	0.63	0.50	0.58	0.57	0.55

# Model assisted/based monitoring design



# Sustained monitoring

## Sustained environmental monitoring

- some hazards occur at large spatio-temporal scales
- implicit expectation that monitoring will occur at equivalent scale
- well established precedent large scale monitoring of epidemiological outcomes
- relatively poor precedent for large scale monitoring of environmental outcomes

## Some challenges

- securing and maintaining funding
- establishing causality at landscape scales
- monitoring targets

# References

- Hayes, K. R., Greg, g. P. C., Gupta, V., Jessop, R., Lonsdale, W. M., Sindel, B., Stanley, J., and Williams, C. K. (2004). Identifying hazards in complex ecological systems. part 3: Hierarchical holographic model for herbicide tolerant oilseed rape. *Environmental Biosci*, 3:109–128.
- Thomas, C. J., Cross, D. E., and Bogh, C. (2013). Landscape movements of *Anopheles gambiae* malaria vector mosquitoes in rural gambia. *PLoS ONE*, 8(7):e68679.
- WHO (2009). Progress and prospects for the use of genetically modified mosquitoes to inhibit disease transmission. Technical report, World Health Organisation, Geneva, Switzerland.

# Thank You

## CSIRO Health and Biosecurity

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