Decision support system for prioritising biosecurity actions on islands

Cheryl Lohr, Keith Morris, Lesley Gibson Bob Pressey, Jana Brotankova, Amelia Wenger

WA Department of Parks and Wildlife

James Cook University, Townsville

Net Conservation Benefits Funded Project 2012-2017

Systematic Conservation Planning

- Prioritise conservation actions
- Explicitly identify valued features and management units
- Set quantitative goals for features

MARXAN
conservation solutions

RobOff
Software for robust offsetting, habitat restoration, maintenance and management

Plan

Wiens et al. 2015

Buffer zones

PacMARA
Pacific Marine Analysis & Research Association

- Optimisation algorithm find most *cost-effective* reserve network

Systematic Conservation Planning

- Prioritise conservation actions
- Explicitly identify valued features and management units
- Set quantitative goals for features
- Link features – threats – management actions
- Optimisation algorithm find most *cost-effective* action

MARXAN
conservation solutions

RobOff
Software for robust offsetting, habitat restoration, maintenance and management

Plan

Wiens et al. 2015

Buffer zones

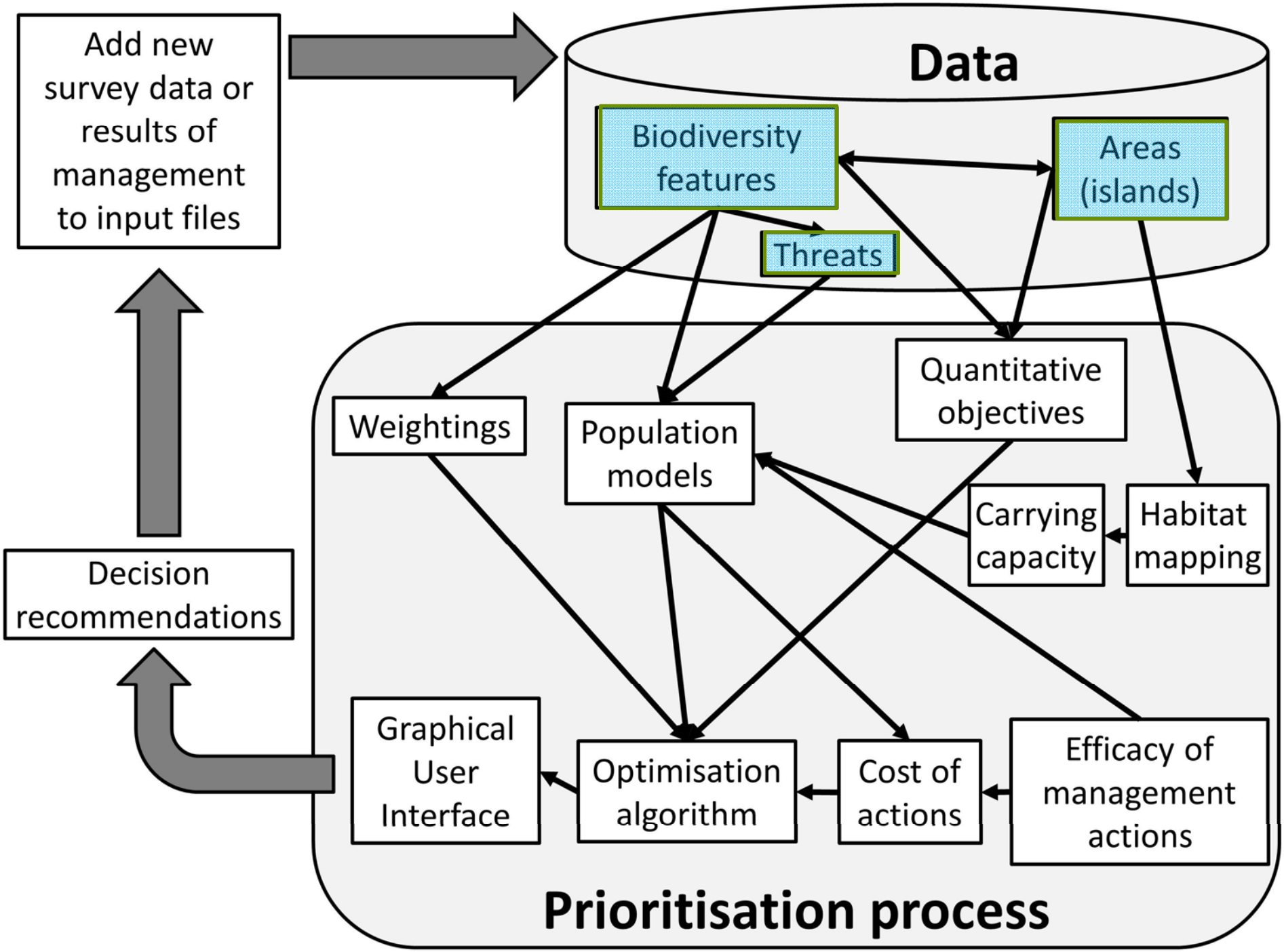
PacMARA
Pacific Marine Analysis & Research Association

Burbidge 1996, Hermite Is rat eradication

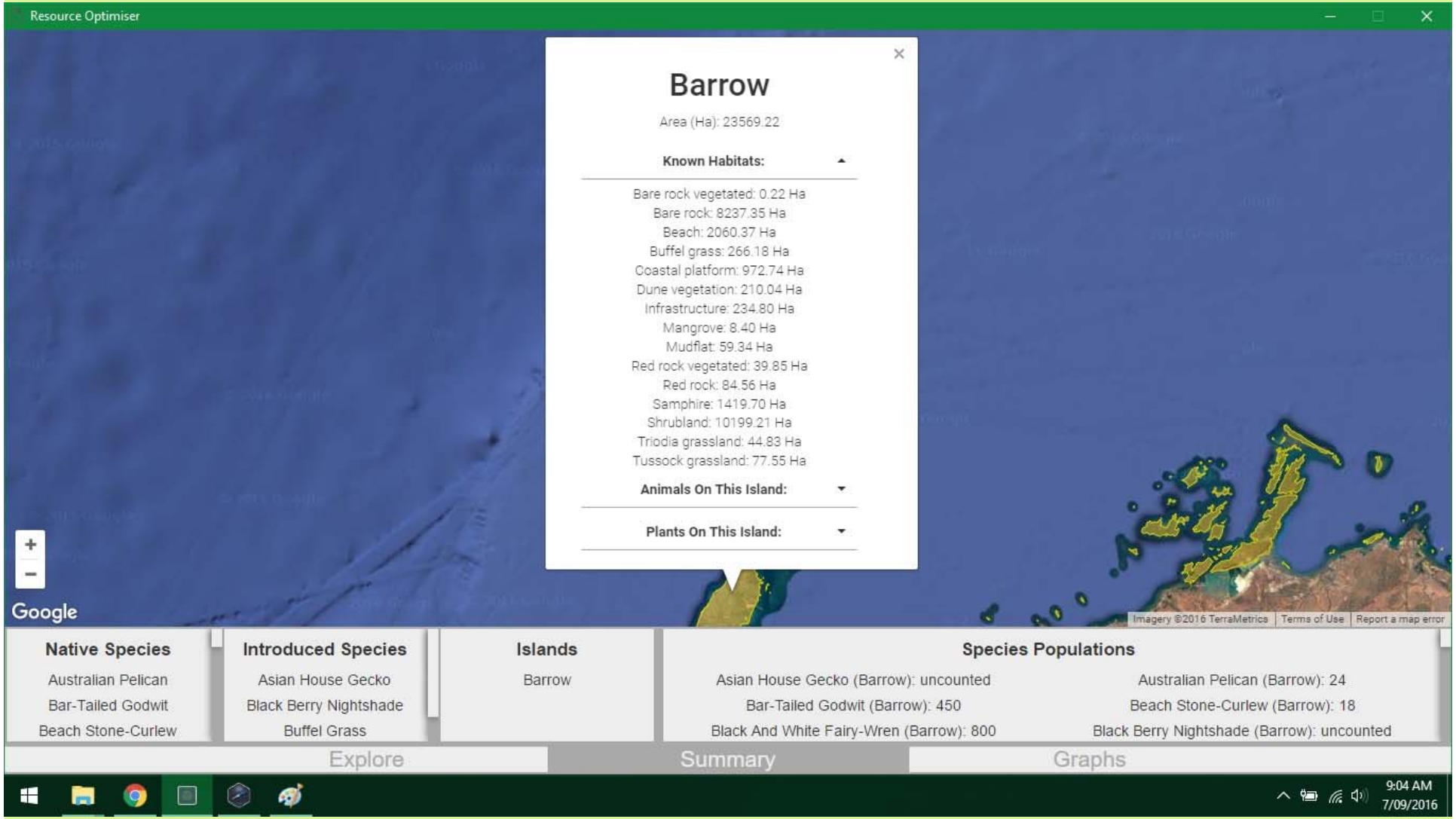
Ryan McMinds 2014, Wikimedia

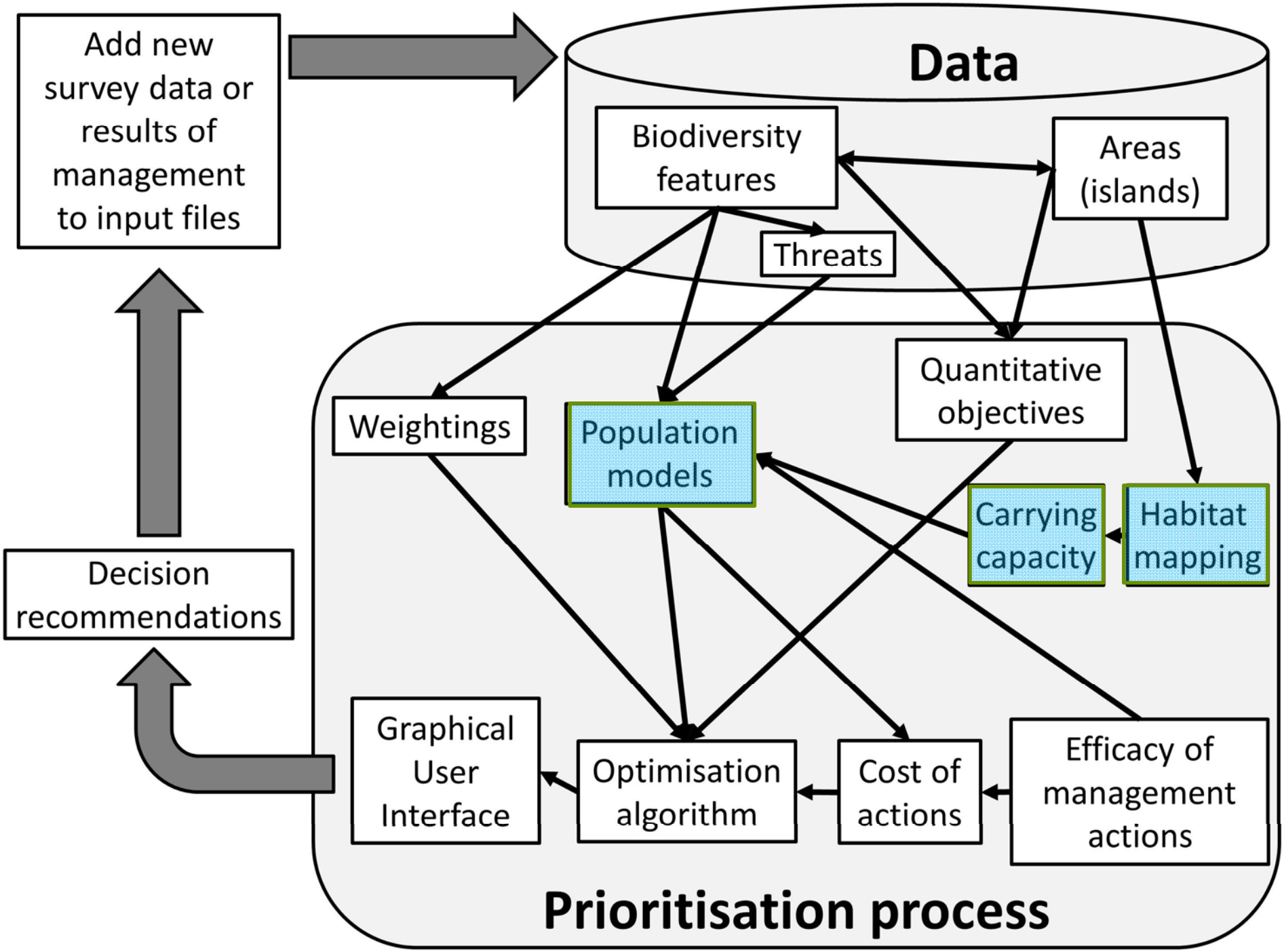
Van Dongen 2013, Alpha Is kapok

Kappaphycus sp. and Eucheuma sp. removal DLNR Hawaii, 2013


Add new survey data or results of management to input files
Data
Biodiversity features
Areas (islands)
Threats
Quantitative objectives
Weightings
Population models
Carrying capacity
Habitat mapping
Decision recommendations
Graphical User Interface
Optimisation algorithm
Cost of actions
Efficacy of management actions
Prioritisation process

Islands DSS GUI




Add new survey data or results of management to input files
Data
Biodiversity features
Areas (islands)
Threats
Quantitative objectives
Weightings
Population models
Carrying capacity
Habitat mapping
Decision recommendations
Graphical User Interface
Optimisation algorithm
Cost of actions
Efficacy of management actions
Prioritisation process

Habitat maps

Population models

Equation 1: Space limited species (V_i)

$$V_i(t+1) = \boxed{V_i + r_{mi}V_i\left(1 - \frac{V_i + \sum_{j\in Bi}\alpha_{ij}V_j}{K_iH_i - K_iM_i\frac{\sum_{j\in Ci}\alpha_{ij}V_j}{1+\sum_{j\in Ci}\alpha_{ij}V_j}}\right)} - \boxed{\sum_{j\in Di}\alpha_{ij}V_iN_j} - \boxed{\sum_{\alpha}V_i\left(\frac{\theta_{ai}A_a(t)}{1+\theta_{ai}A_a(t)}\right)}$$

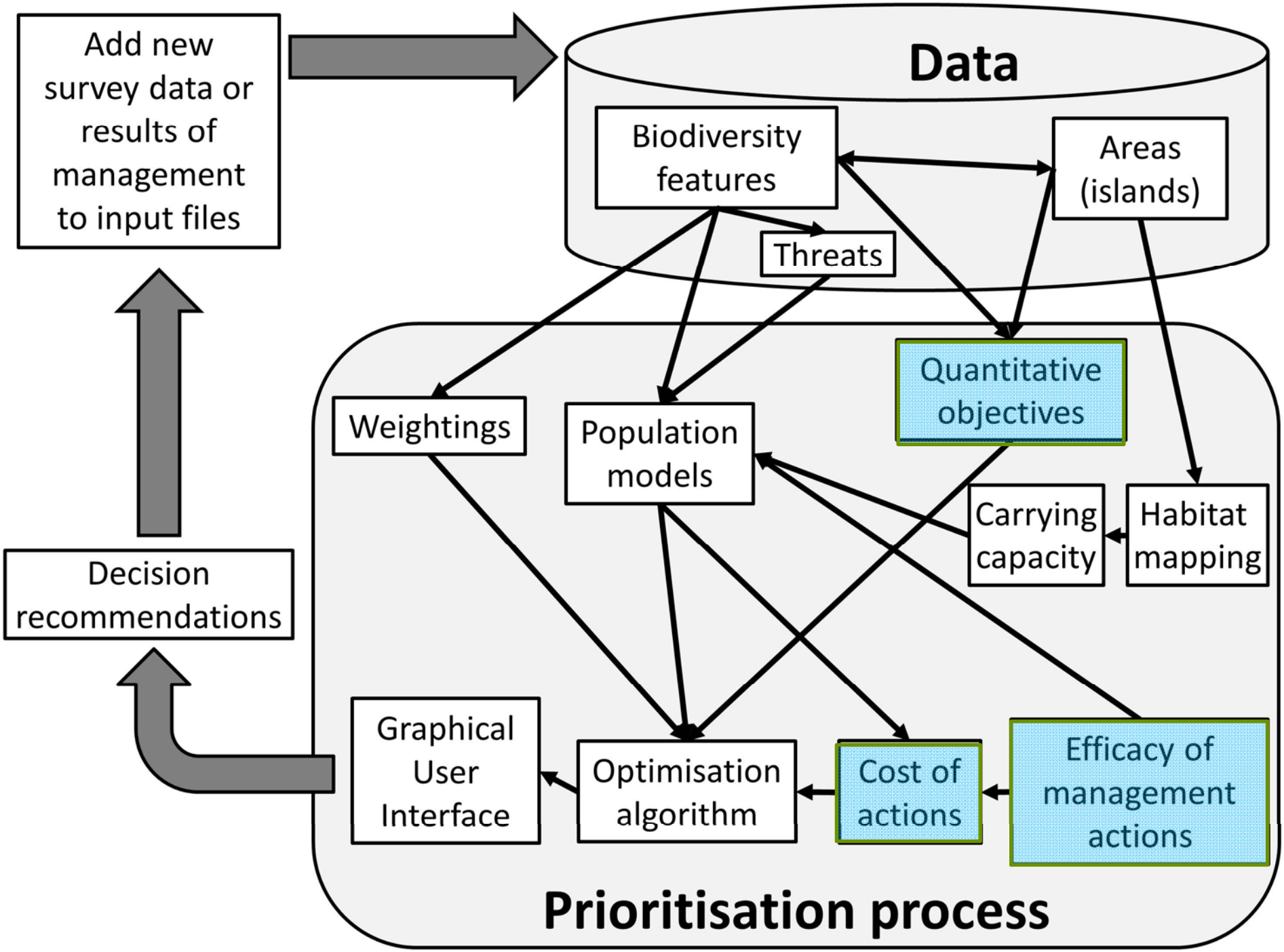
Species growth rate and carrying capacity

Threat sub-model Type I Functional Response

Sigmoidal model contribution of management actions

Equation 2: Consumers (N_i)

$$N_i(t+1) = \boxed{N_i + r_{m_i}N_i\left(1 - J_i\left(\frac{N_i}{\sum F_i}\right)\right)\left(1 - \frac{N_i}{K_i}\right)} - \boxed{\sum_{j\in Di}\alpha_{ij}N_iN_j} - \boxed{\sum_{a}N_i\left(\frac{\theta_{ai}A_a(t)}{1+\theta_{ai}A_a(t)}\right)}$$


Add new survey data or results of management to input files
Data
Biodiversity features
Areas (islands)
Threats
Quantitative objectives
Weightings
Population models
Carrying capacity
Habitat mapping
Decision recommendations
Graphical User Interface
Optimisation algorithm
Cost of actions
Efficacy of management actions
Prioritisation process

Uncertainty in efficacy of management

with cats eating wallabies

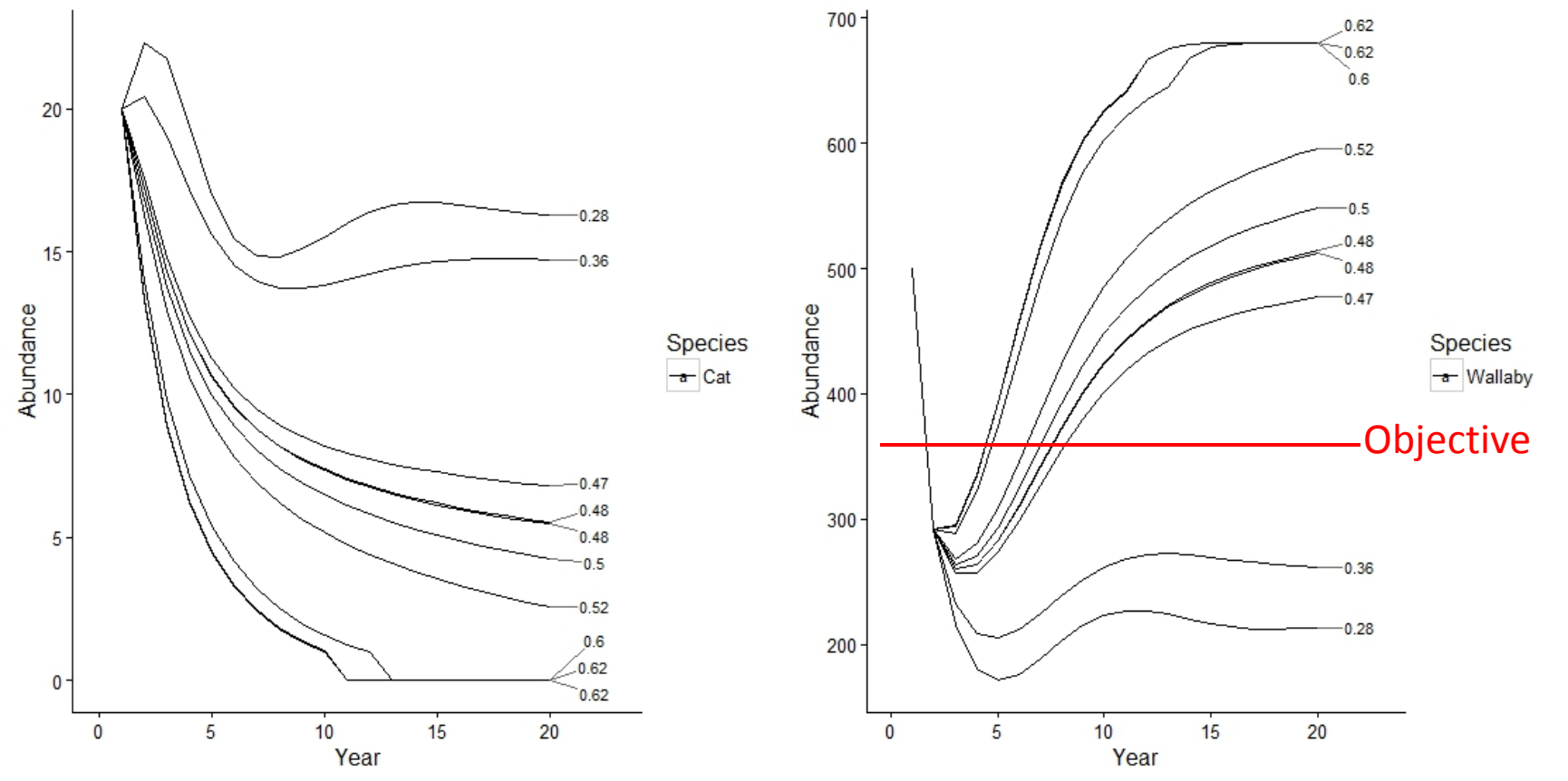
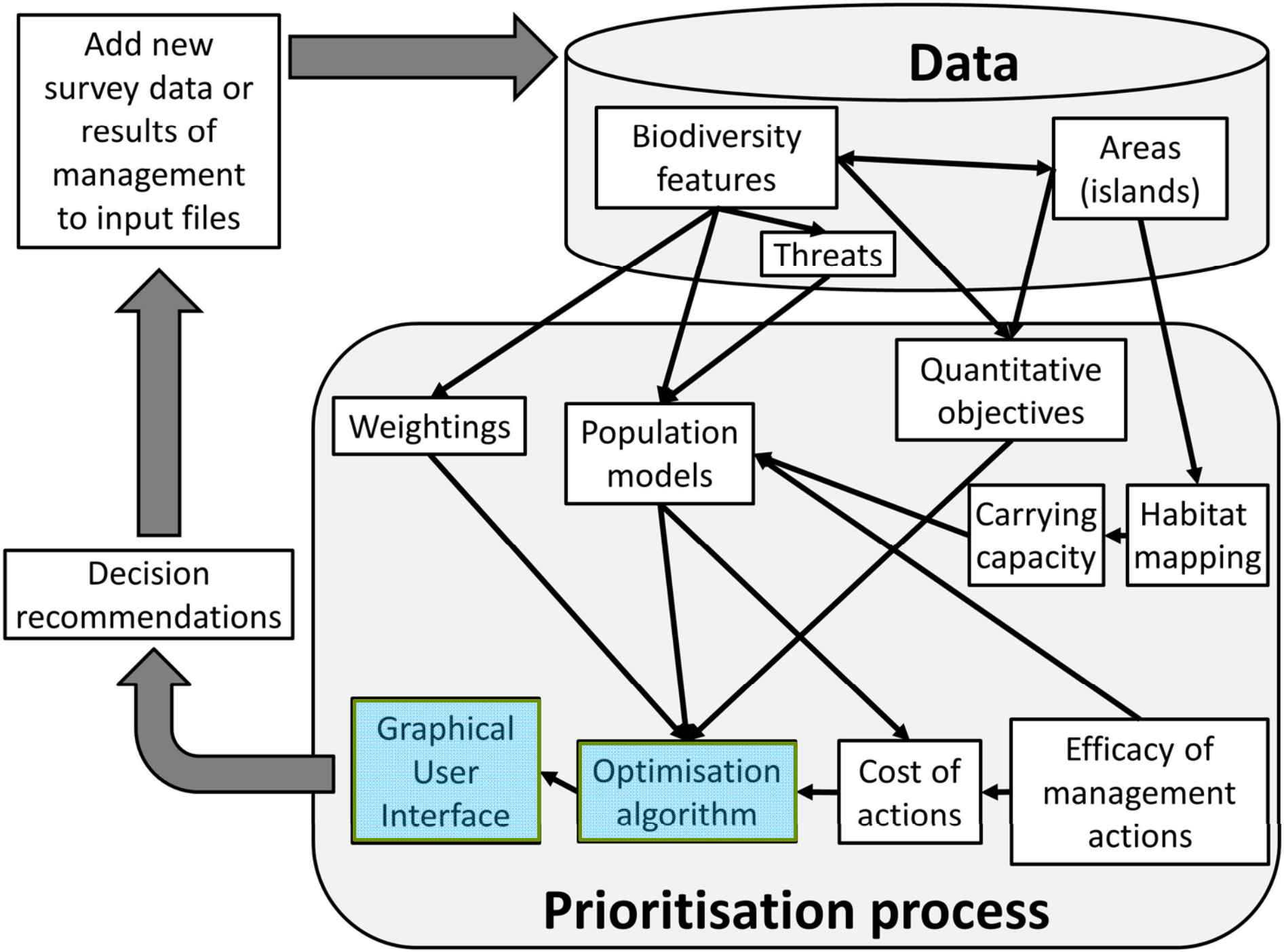


Figure 4: Variation in abundance of cats and wallabies in response to variation in effectiveness of management (ϑ_{cat}) applied annually to the predator.


Add new survey data or results of management to input files
Data
Biodiversity features
Areas (islands)
Threats
Quantitative objectives
Weightings
Population models
Carrying capacity
Habitat mapping
Decision recommendations
Graphical User Interface
Optimisation algorithm
Cost of actions
Efficacy of management actions
Prioritisation process

Marine and Migratory Species?

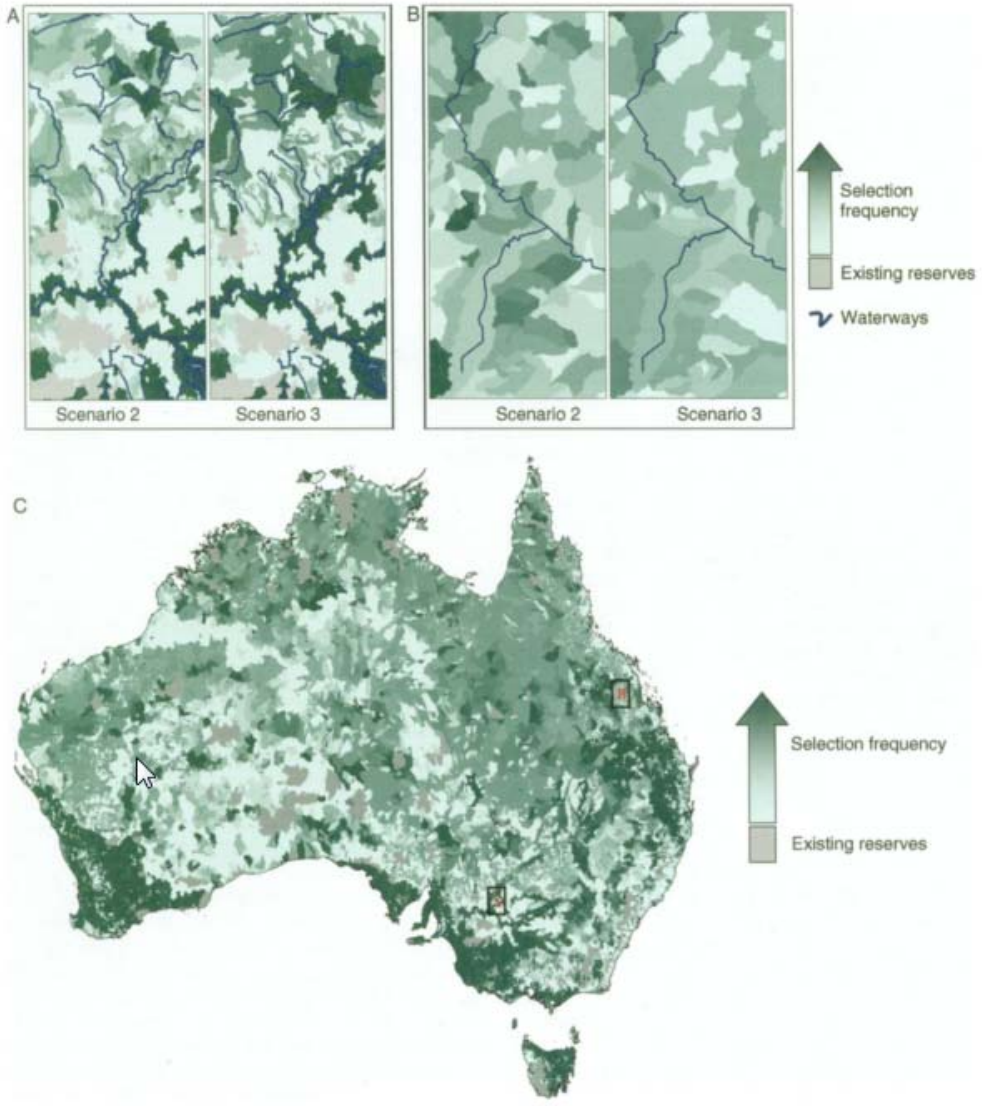
Current species

- Predation of marine turtle nests

Questions

- Does 90% ↓ in hatchlings follow-through to maturity?
- Can we enter life-stages like separate species, each stage has unique threat?
- Is there a carrying capacity for migratory species (flock size vs duration visit)?
- Does human disturbance reduce reproductive potential (ie threat)?

Mainland or Marine Sites?



Klein et al. (2008) Incorporating Ecological and Evolutionary Processes into Continental-Scale Conservation Planning. Ecological Applications **19**, 206-217

Current assumption

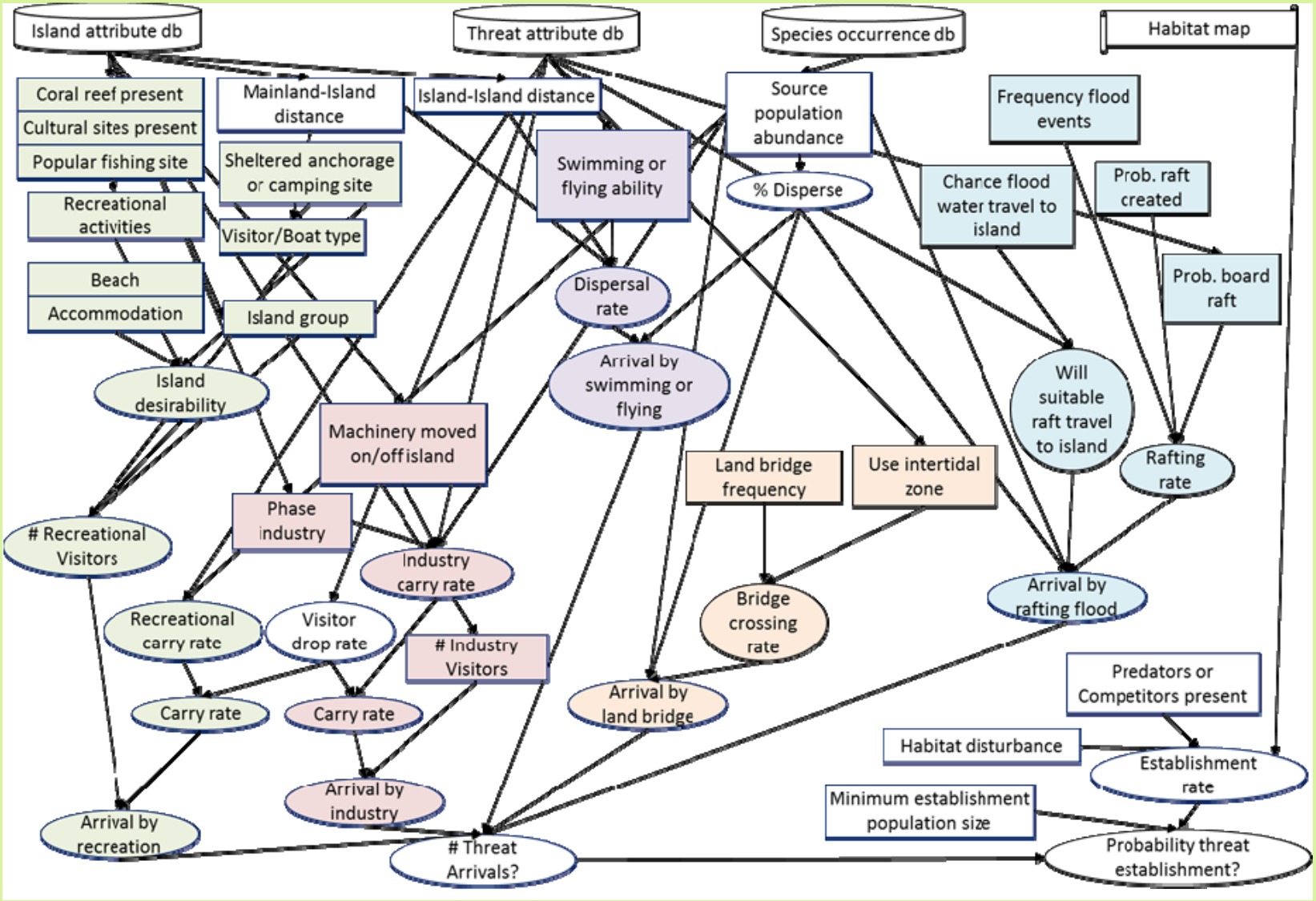
- No dispersal between management units

Future work

- Link island biosecurity BBN to Islands DSS

Biosecurity risk from invasive fauna

Estimating biosecurity risk from introduced fauna for Pilbara islands using Bayesian belief networks: Lohr CA, Wenger A, Woodberry O, Pressey RL, Morris K. Pending permission to use BI QEP data.



What's next?

- Software testing and Pilbara Island scenarios complete Oct 2017.
- Plans for 2018??
  - Train DPaW staff in software use
  - Corporatise databases
  - Next generation of software??