Collectives

EES 4760/5760

Agent-Based & Individual-Based Computational Modeling

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Class #18: Thursday Mar. 16 2017

Wild Dog Model

https://ees4760.jonathangilligan.org/models/class_18/wild_dogs.nlogo

https://ees4760.jonathangilligan.org/models/class_18/jg-tif.nls

https://ees4760.jonathangilligan.org/models/class_18/wild_dog_odd.pdf

Breeds of Turtles

```
breed [dogs dog]
breed [cats cat]

globals []

turtles-own
[
  sex
  age
]

dogs-own
[
  has-ball?
]

cats-own
[
  has-scratching-post?
  claw-length
]
```

Breeds and Contexts

- All breeds are evaluated in turtle context.

```
to go
  tick

  ask turtles [ set age age + 1 ]
  ask dogs [ if has-ball? [ fetch ] ]
  ask cats [ if has-scratching-post? [ scratch ] ]
  ask turtles [
    ; this will make an error
    if has-scratching-post? [ scratch ]
  ]
end
```

- Common error: Ask one breed (wolf) to do another breed’s (sheep’s) function.

Checking for Errors:

Good idea: Check that the right breed is calling the function:

```
to do-cat-stuff
  if not is-cat? self
  [
    print (word "Error: turtle " self " is not a cat.")
    stop
  ]

  if has-scratching-post? [ scratch ]
end
```

Or, if you’re using `jg-tif.nls`, you can do this:

```
to do-cat-stuff
  test-that (word "do-cat-stuff: turtle " self " should be a cat.")
  expect-that is-cat? self is-true

  if has-scratching-post? [ scratch ]
end
```

Turtles vs. Breeds

- If you have breeds, there will still always be `turtles`.
- `ask turtles [...]` will ask all breeds of turtle.
- `ask dogs [...]` will only ask the dogs.
- Many `turtles-` commands have a breed-specific version:

```
if any? turtles-here
[
  ask turtles-here [forward 10]
]

if any? dogs-on neighbors and any? cats in-radius 5
[
  ask dogs-on neighbors
  [
  chase min-one-of cats [distance myself]
  ]
]
```

Breeds of links

- Links can also have breeds.

```
undirected-link-breed [friendships friendship]   ; between friends
directed-link-breed [children-of child-of]       ; from parent to children
directed-link-breed [employees employee]         ; from boss to employees

to befriend [ new-friend ]
  create-friendship-with new-friend ; create friendship
end

to breed [ n ] ; executed in context of parent
  create-turtles n [
    create-child-of-from myself ; points from parent to new turtle
  ]
end

to hire [ employee-set ]
  create-employees-to employee-set
end
```

More about Breeds

- You can change the breed of a turtle or link with `set-breed`:

```
ask one-of cats [ set breed dog ]
ask one-of friendships [ set undirected-link-breed enmities ]
```

- You can specify the default shape of new individuals of a breed (doesn’t affect any already created)

```
set-default-turtle-shape "circle"
create-cats 1 ; default turtle shape

set-default-shape cats "cat"
set-sefault-shape dogs "dog"
create-cats 1 ; has "cat" shape

ask one-of cats [ set breed dogs ] ; cat becomes a dog and changes shape to "dog"
```

- **Note:** some shapes, like “cat” and “dog” must be imported into the model from the shapes library, using the shapes editor

Wild Dog Model

Wild Dog Model

- Adapted from Markus Gusset *et al.*, “Dogs on the Catwalk: Modelling Re-Introduction and Translocation of Endangered Wild Dogs in South Africa.” Biological Conservation **142**, 2774–81 (2009).

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https://ees4760.jonathangilligan.org/models/class_18/jg-tif.nls

Survival of endangered wild dogs (*Lycaon pictus*) in South African nature reserves.

- Dogs form packs
- Dogs in packs have social structure:
  - **Alpha**: One male, one female
  - **Subordinate adults**
  - **yearling** (1–2 years old)
  - **pup** (<1 year old)
- When juvenile dogs reach adulthood, if they can't be dominant (alpha): decide whether to
  - leave pack (disperse), either alone or with adult siblings of same sex,
  - or stay and hope to become alpha one day.
- Disperser groups are single-sex.
  - When opposite-sex disperser groups meet, if they are not from same birth-pack, they may join and form a new pack.
- Disperser dogs have very high mortality rates.

Detailed rules:

- Dispersal:
  - Two or more subordinates of same sex: always disperse
  - One subordinate of its sex: 50% probability to disperse
- Mortality (probability of dying each tick)

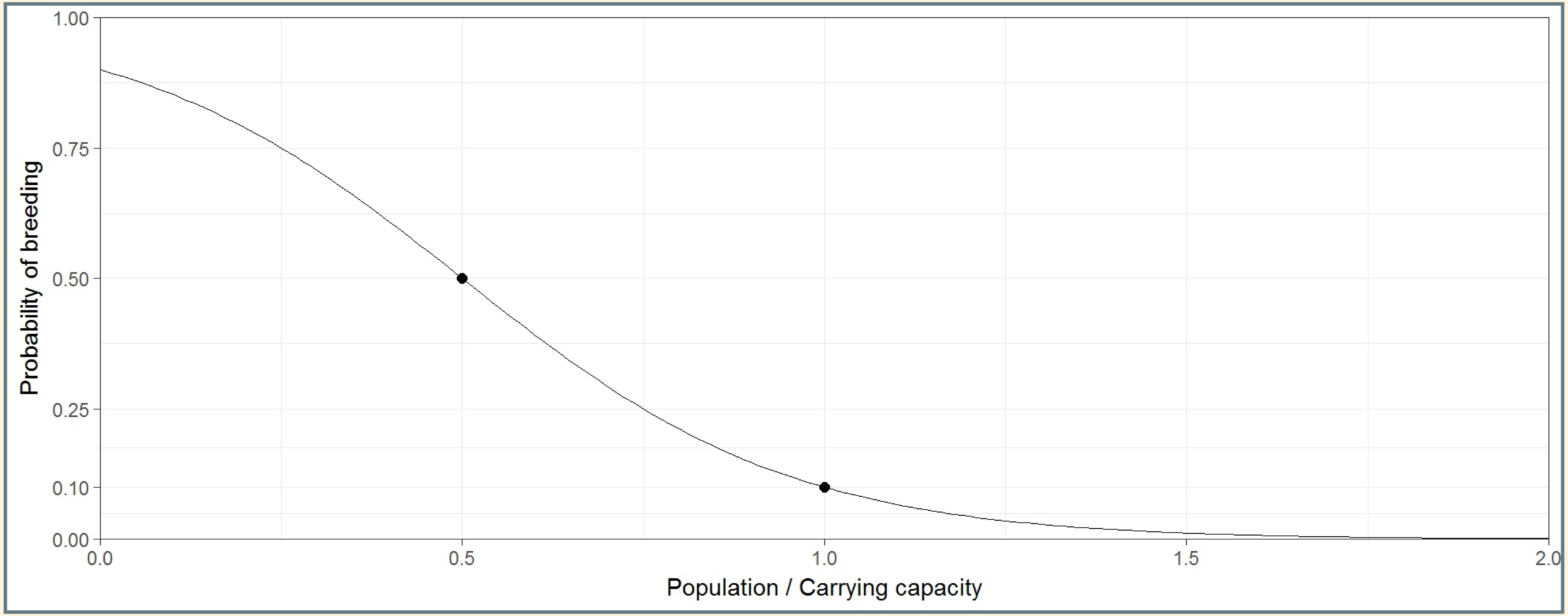
Status	**Mortality**
Pup	12%
Yearling	25%
Subordinate or alpha	20%
Disperser	44%

Management Options

- Increase size of park:
  - Larger park has greater carrying capacity
  - Larger park makes it harder for disperser groups to meet.
- Decrease mortality of dispersers.

Characteristics of Dogs

- Frequency of breeding depends on ratio of population to carrying capacity:



- When population is 50% of carrying capacity, probability of breeding is 50%
- When population is 100% of carrying capacity, probability of breeding is 10%

Programming aspects

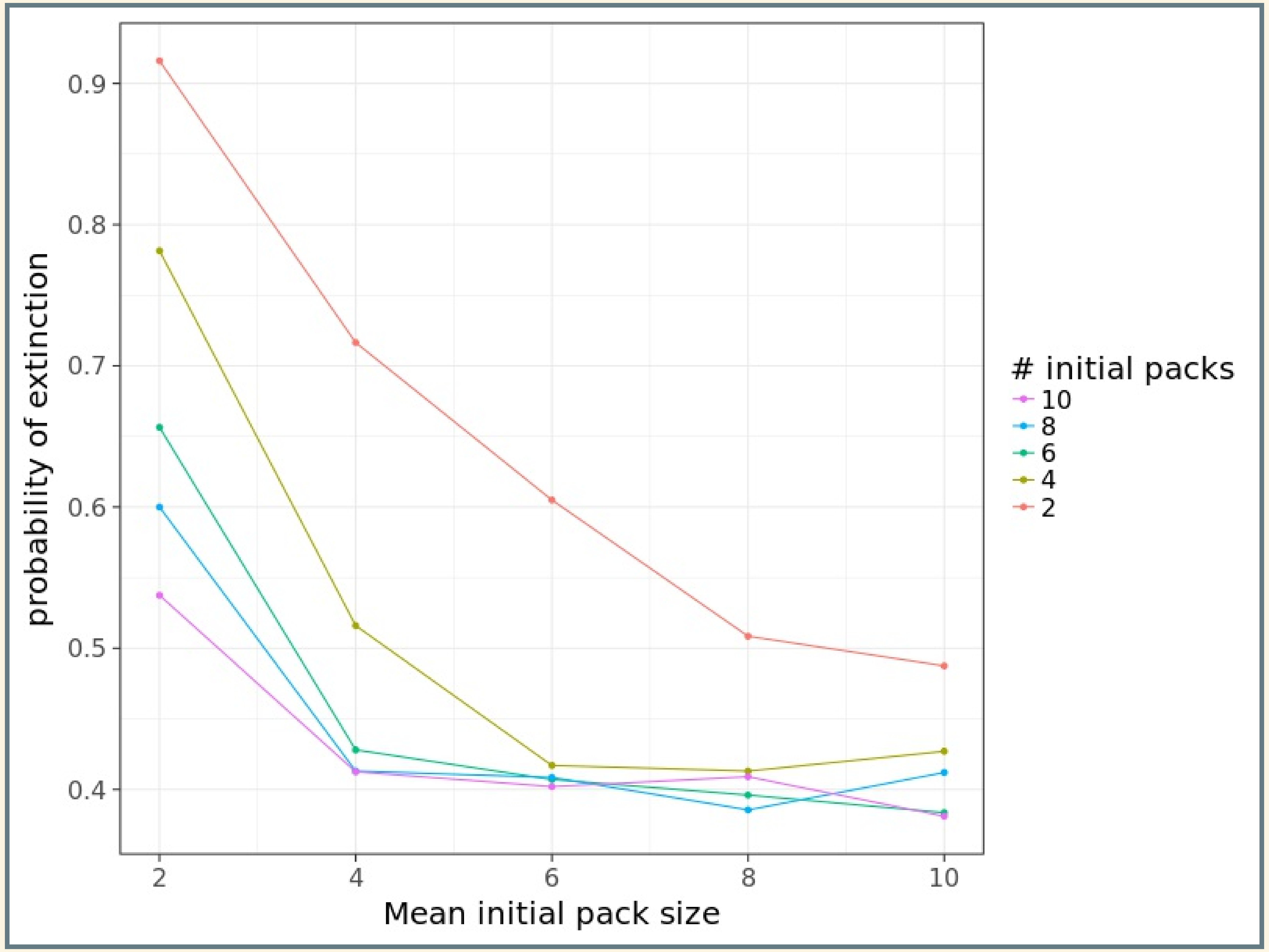
- Lots of things to keep track of.
- At end of each tick:
  - Social status must match age
  - A pack can have at most one alpha of each sex
  - A pack can’t have subordinates without an alpha of that sex (they would become alpha)
  - A pack can’t have more than one subordinate of each sex (they would disperse)
  - All dogs in disperser packs have status “disperser”
- Good to implement consistency checks to make sure packs and dogs follow these rules.

Calculating Probability of Extinction within 100 years

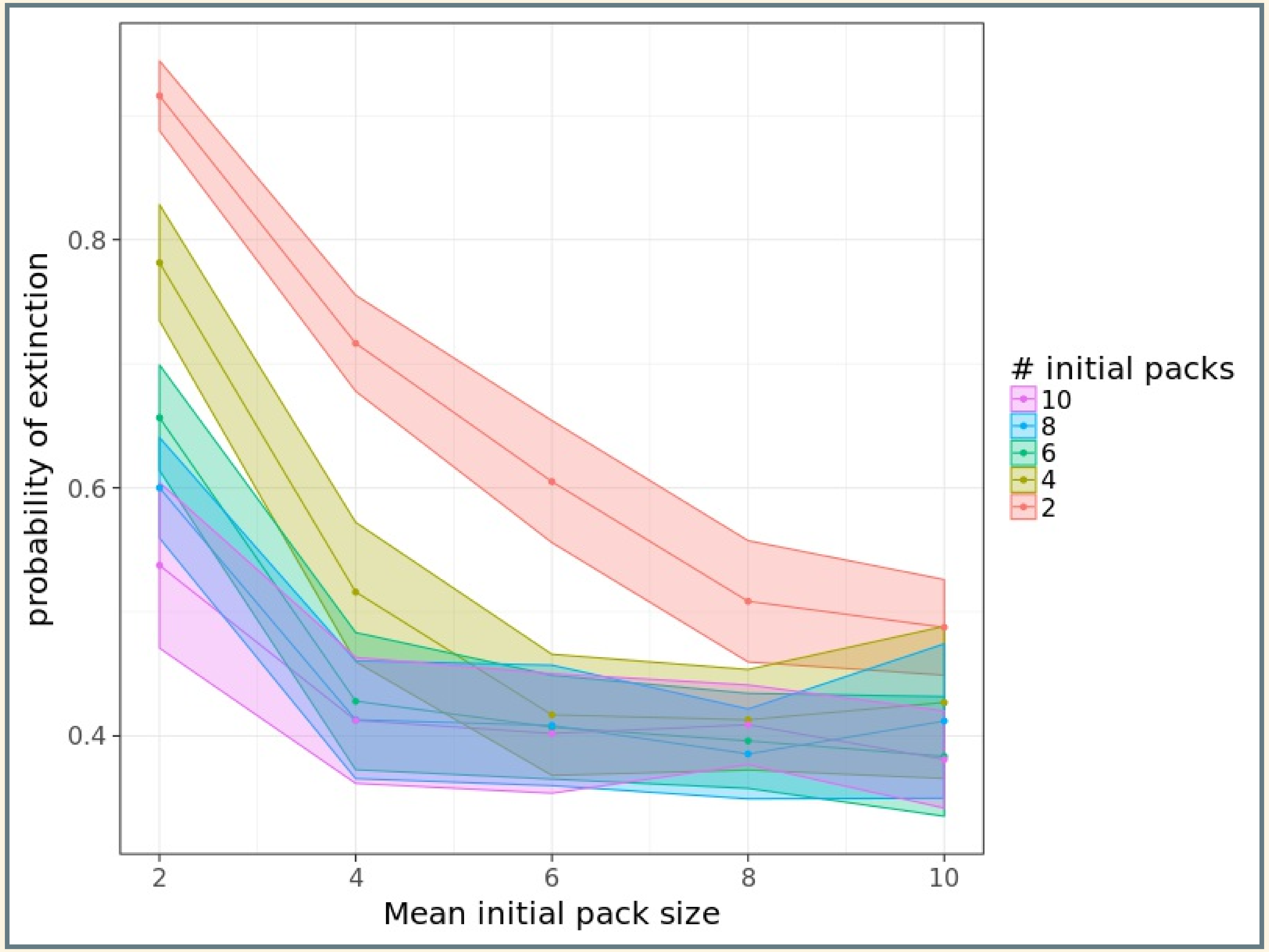
```
to go
  if ticks >= years-to-simulate or not any? dogs
  [
    if ticks < years-to-simulate
    [
      set time-to-extinction ticks
      set extinct? true
    ]
    stop
  ]
  step ; "step" does all the work of mating, aging, dispersing, dying, etc.
end

to get-p-extinct [ n-runs ]
  let n-extinct 0
  repeat n-runs
  [
    setup
    while [ticks < years-to-simulate and not extinct?] [ go ]
    if extinct? [ set n-extinct n-extinct + 1 ]
  ]
  set p-extinction n-extinct / n-runs
end
```

Behaviorspace Experiments

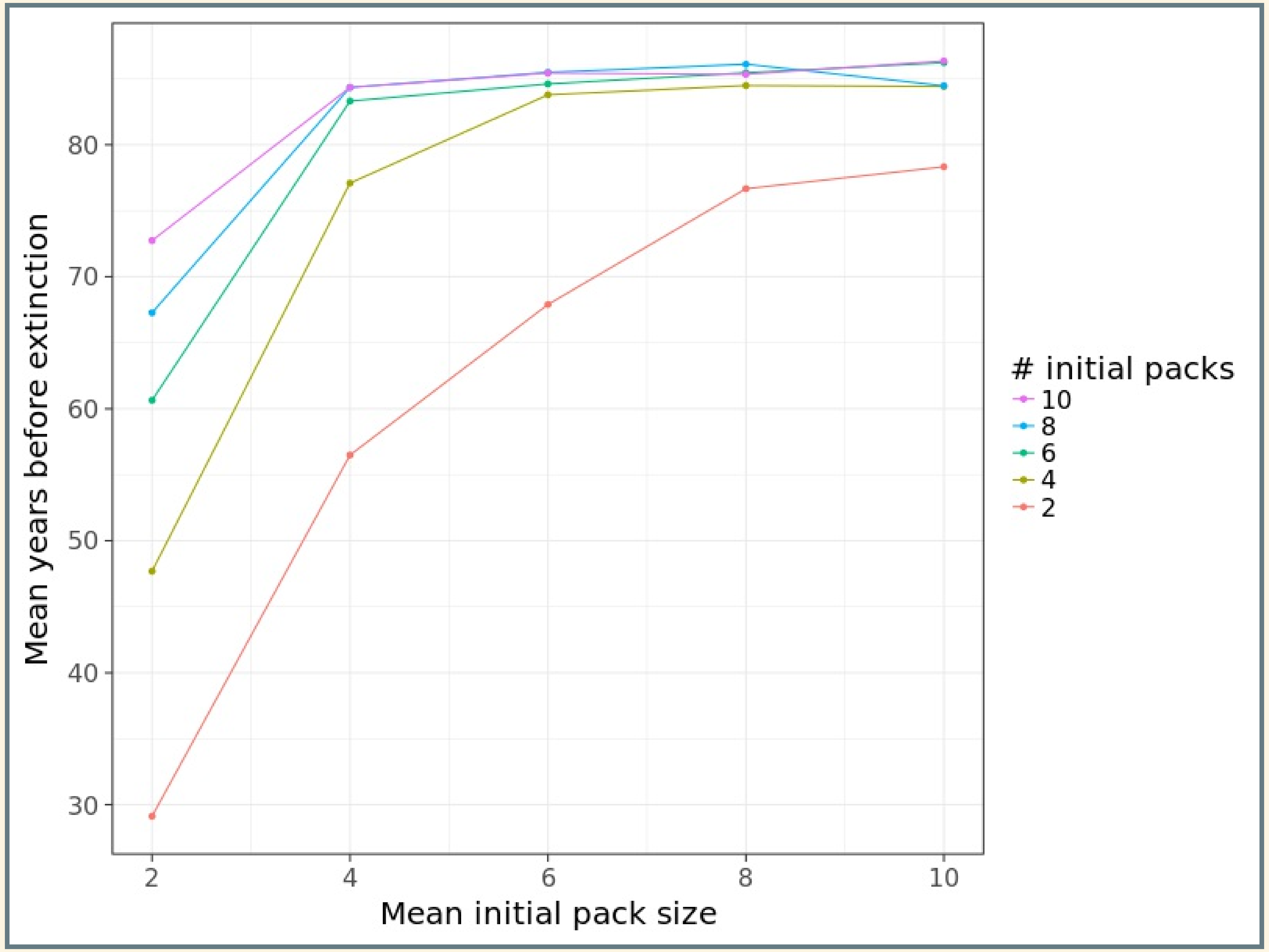
Vary Initial Conditions



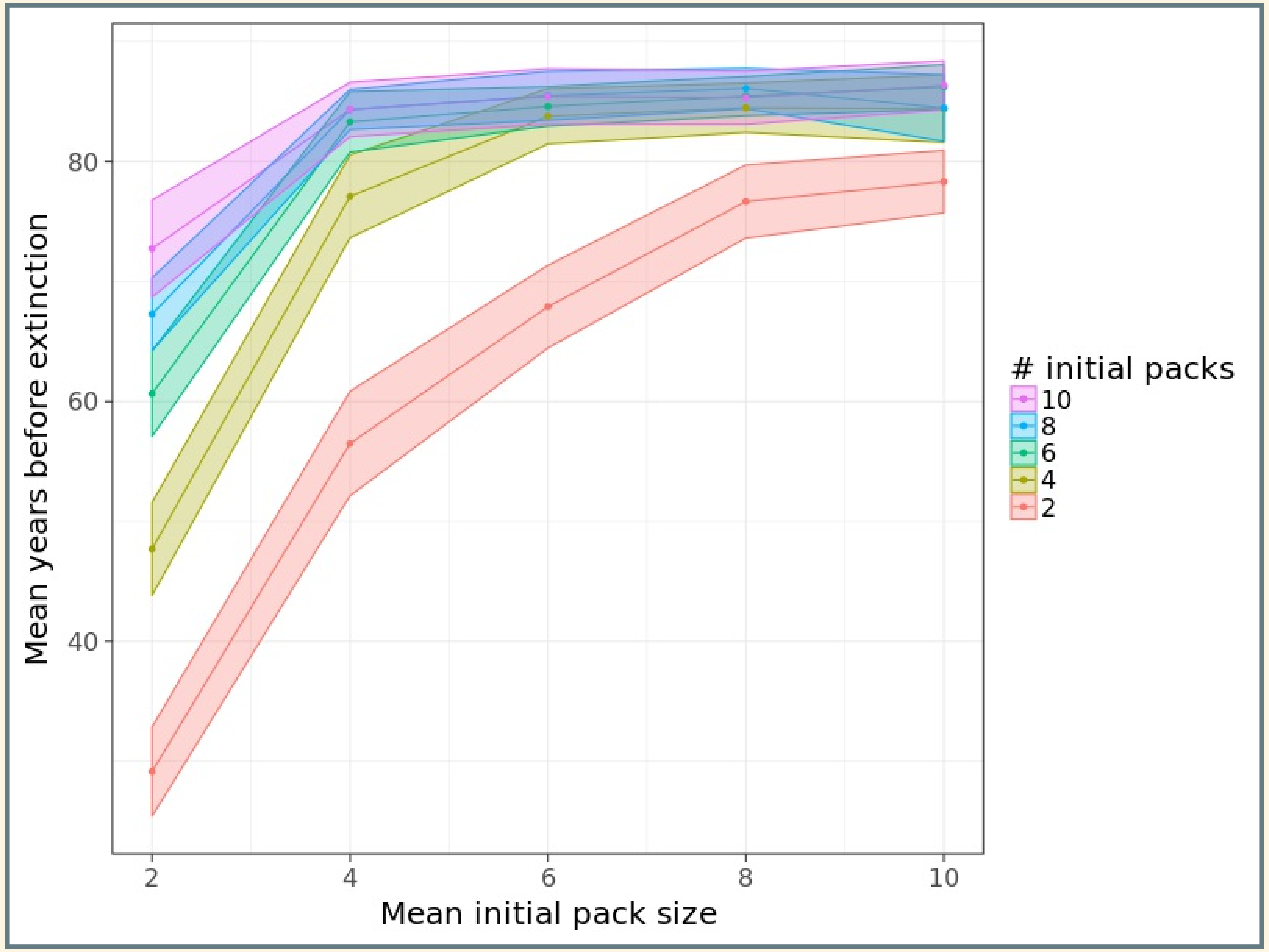
Vary Initial Conditions



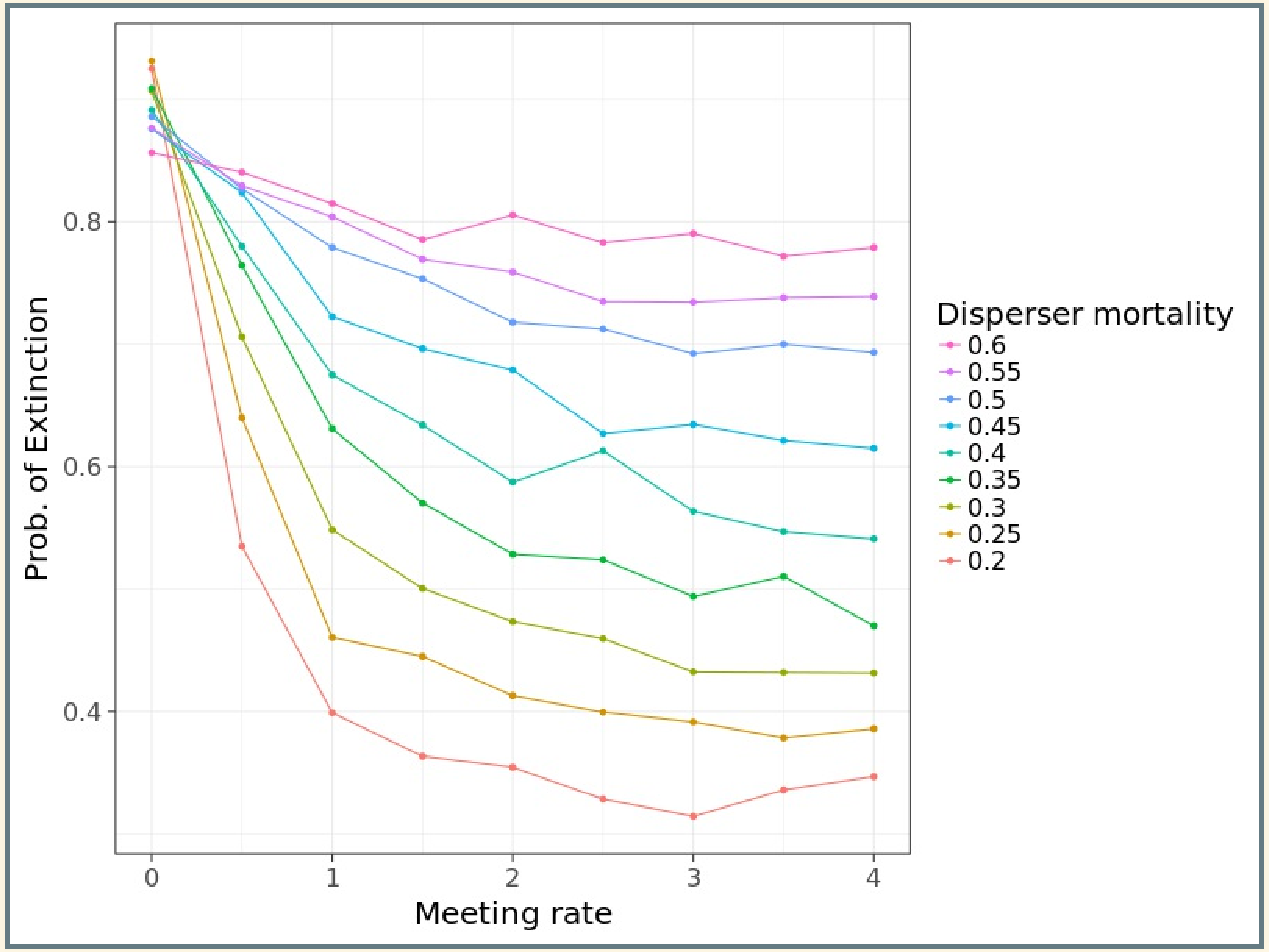
Mean time to extinction



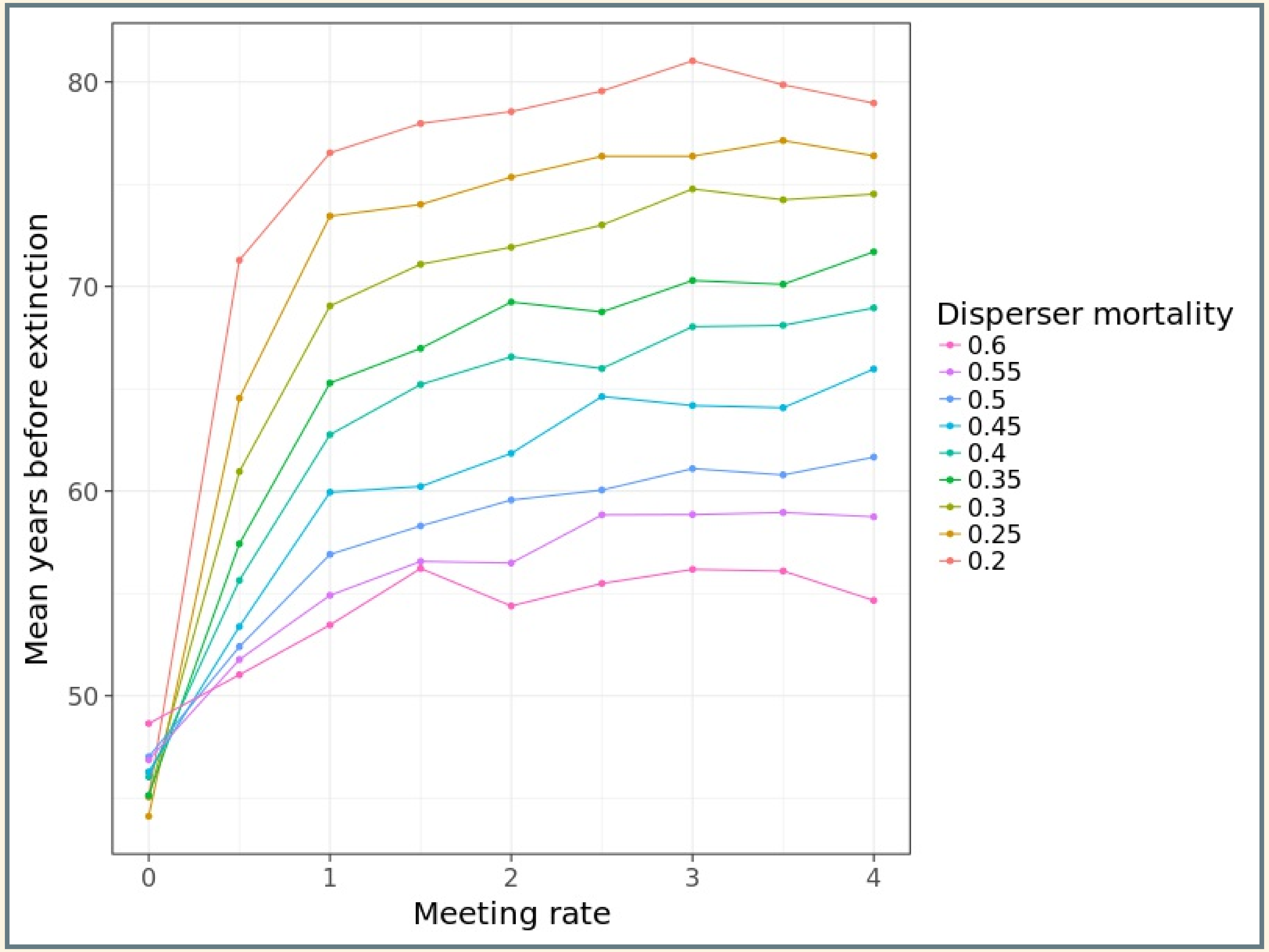
Mean time to extinction



Vary Disperser Group Meeting Rate



Vary Disperser Group Meeting Rate


Mean years before extinction
Meeting rate
Disperser mortality