Applied Behavioural Ecology

Bob Farmer

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- Behavioural Ecology
  - The study of animal behaviour in the context of evolutionary fitness
- “Applied”
  - Generating practical research

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- Understand and predict behaviour of the study species for their (or our) gain
  - Not always easy

Applications

Animal Welfare

Conservation

Pest Control

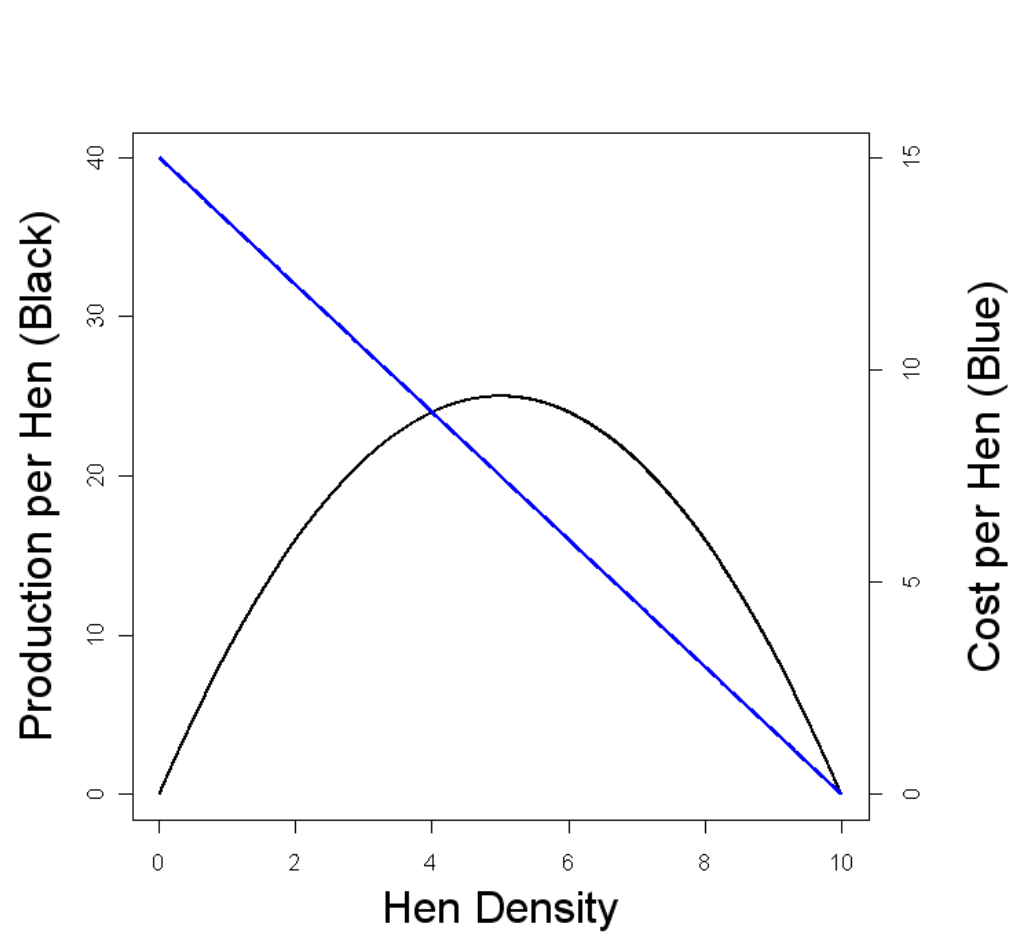
Livestock Productivity

Animal Welfare: The Conflict

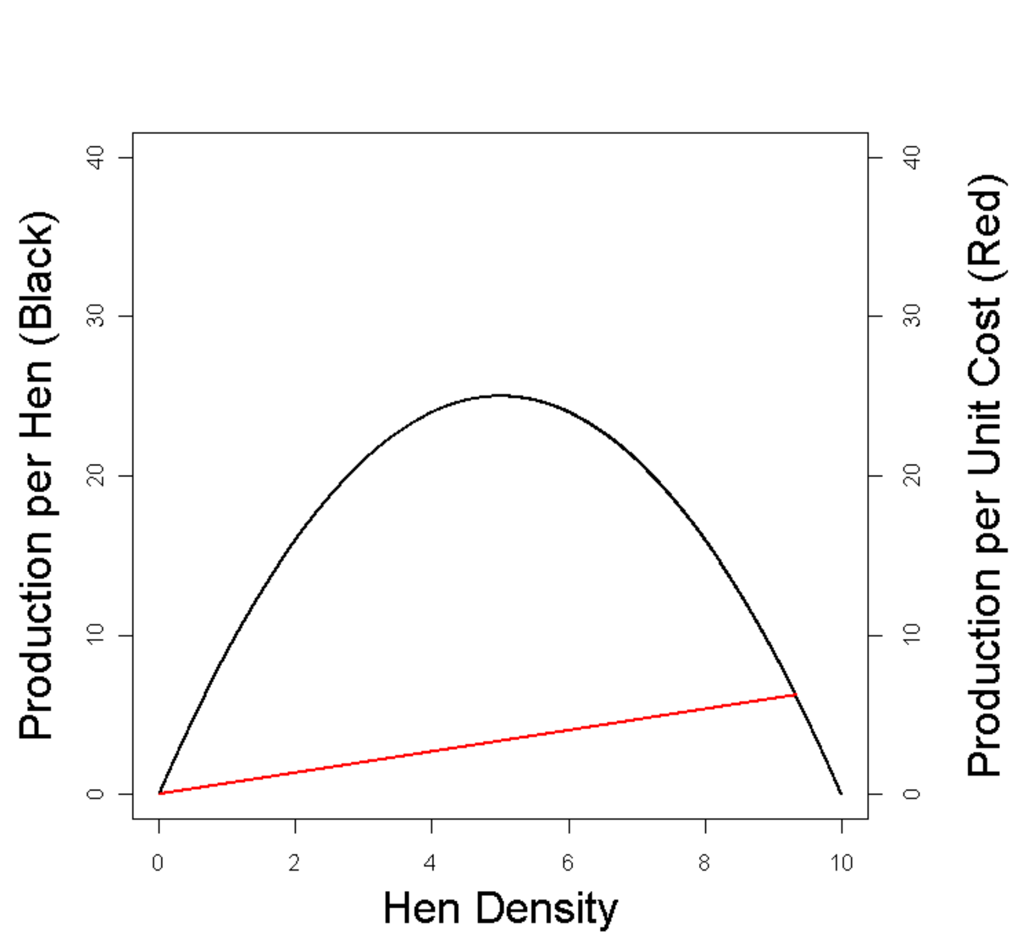
Note that these graphs are conceptual; the real scenario isn't so simple!

Animal Welfare: The Conflict

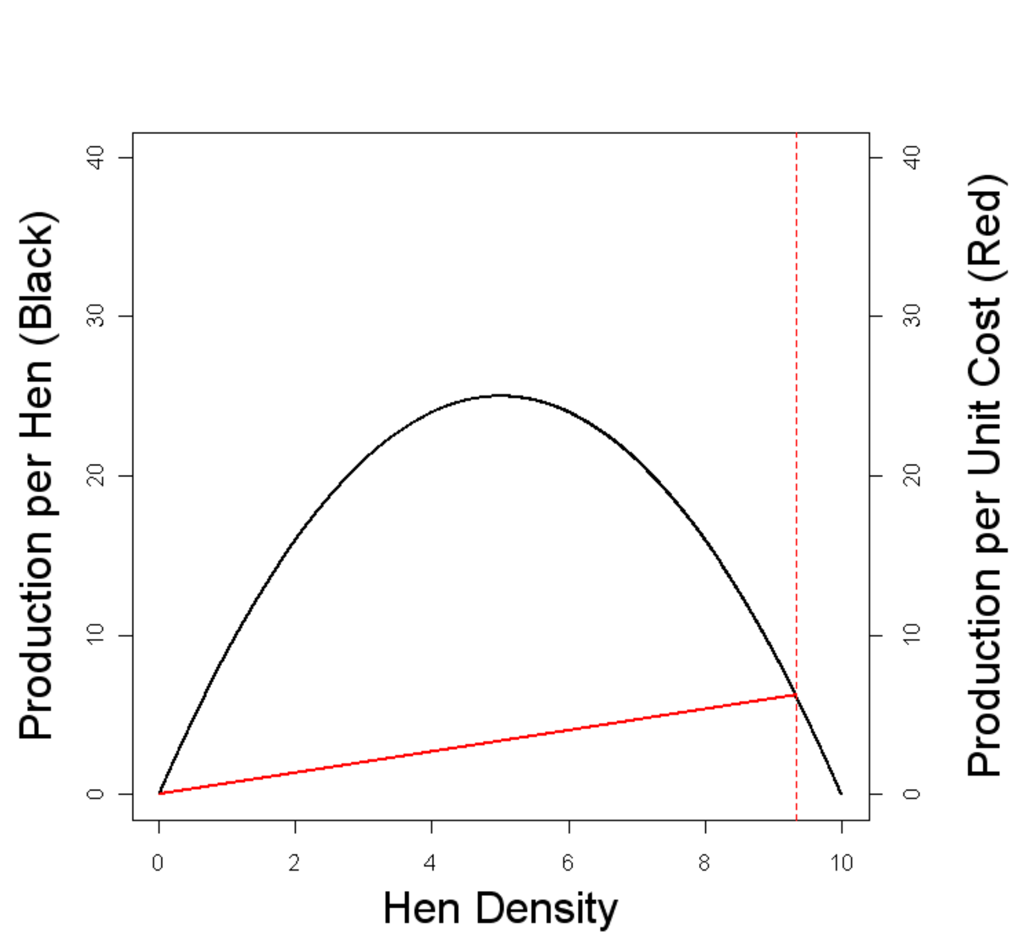
Animal Welfare: The Conflict



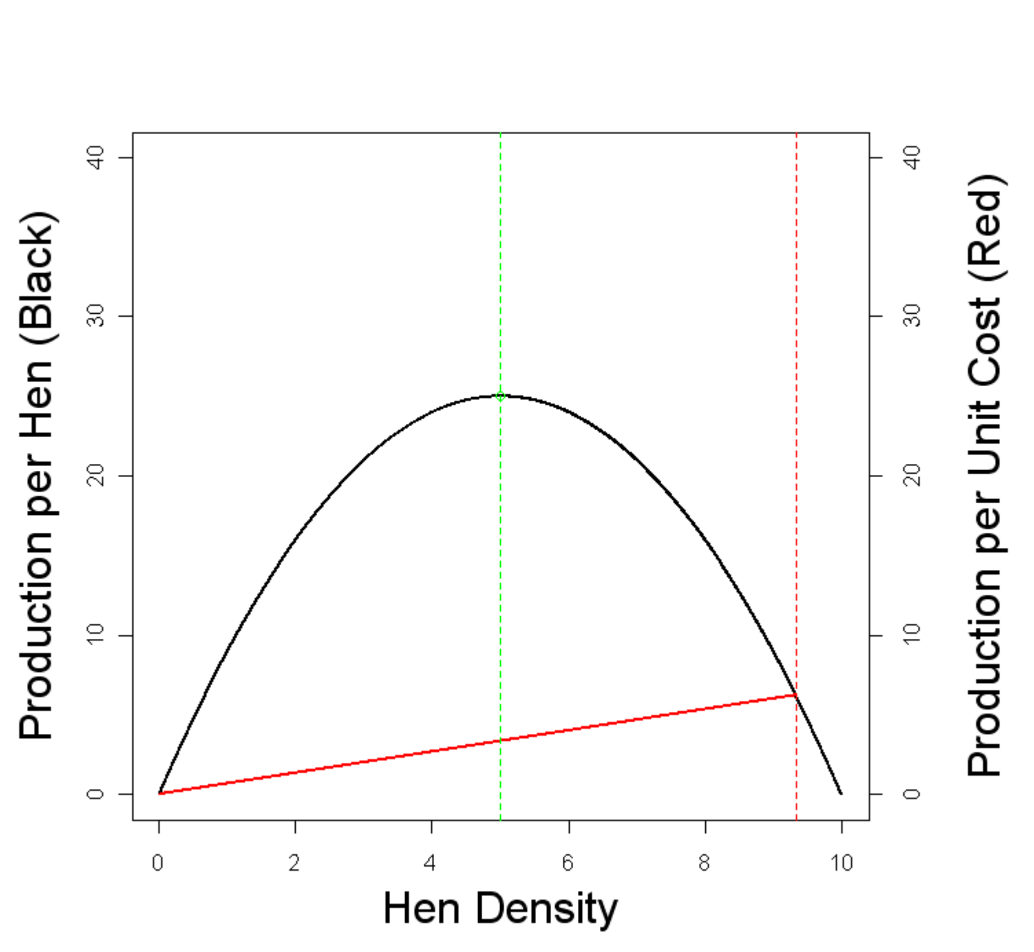
Animal Welfare: The Conflict



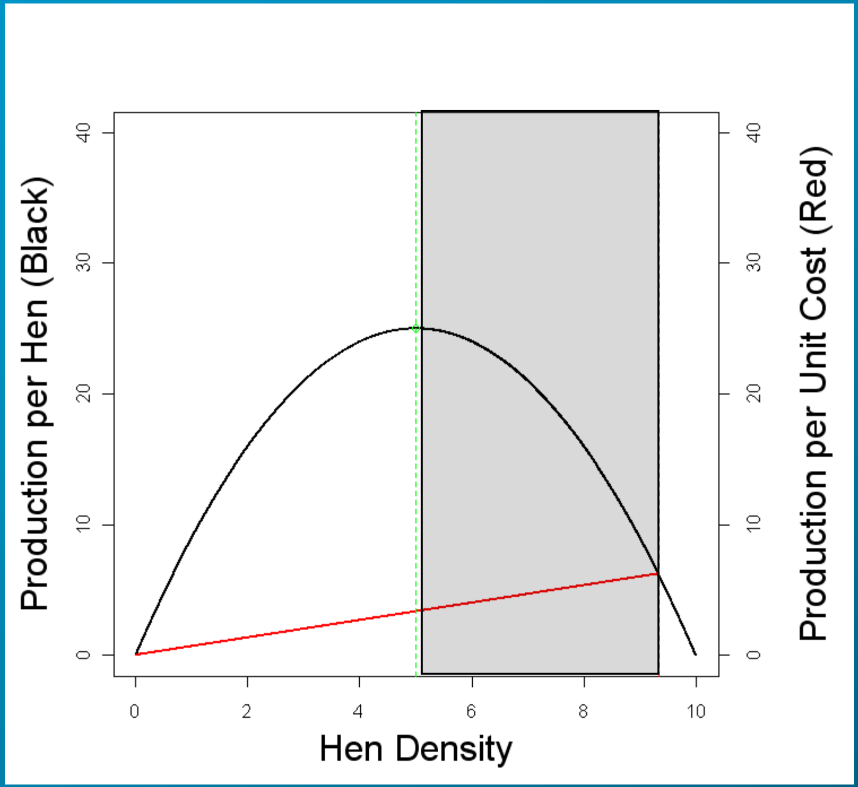
Animal Welfare: The Conflict



Animal Welfare: The Conflict



Animal Welfare: The Conflict



- Need to define "stress" to help subjectively decide on a compromise density

Example: Chicken Stress Levels

- Cortisol (stress hormone) most common measure of animal stress
  - Levels vary for other reasons:
    - Circadian rhythms
    - Age
    - Species, breed
    - Sampling method
- Use BE techniques to standardize measurement

Mormede et al. 2007

- BE can guide environmental modifications, encouraging wild-type behaviours:
  - Perches, foraging substrates improve egg production, reduce aggression

Hester 2005

Improving Animal Welfare

- Objective study of “stress”
- Wild-type behaviours more easily replicated

Sex Ratios

- Fisher (1930)
  - 50/50 is ESS

Sex Ratios

- Trivers and Willard (1973)
  - Optimal reproductive investment strategies conditional on mother and offspring health
  - (with assumptions)

Sex Ratios

- Male kids have a greater average payoff in good condition
- Female offspring are “the best of a bad situation”
  - Red deer, seals, dogs, pigs,…

	Male offspring	Female Offspring
Good condition	*****	**
Lousy condition	-	*

Sex Ratios in Agriculture

- Baseline dairy cattle sex ratio 52:48 (M:F) (Skjervold and James, 1979 *in* Roche et al. 2006)
- Cows in better condition between last calving and conception have more males (Roche et al. 2006)

- BE theory allows non-invasive sex ratio prediction and manipulation of livestock

Manipulate insect behaviour with chemicals

Biocontrol of Corn Earworms

- Corn earworms feed on corn ears
- A parasitoid wasp (*T. pretiosum*) destroys earworm eggs

Biocontrol of Corn Earworms

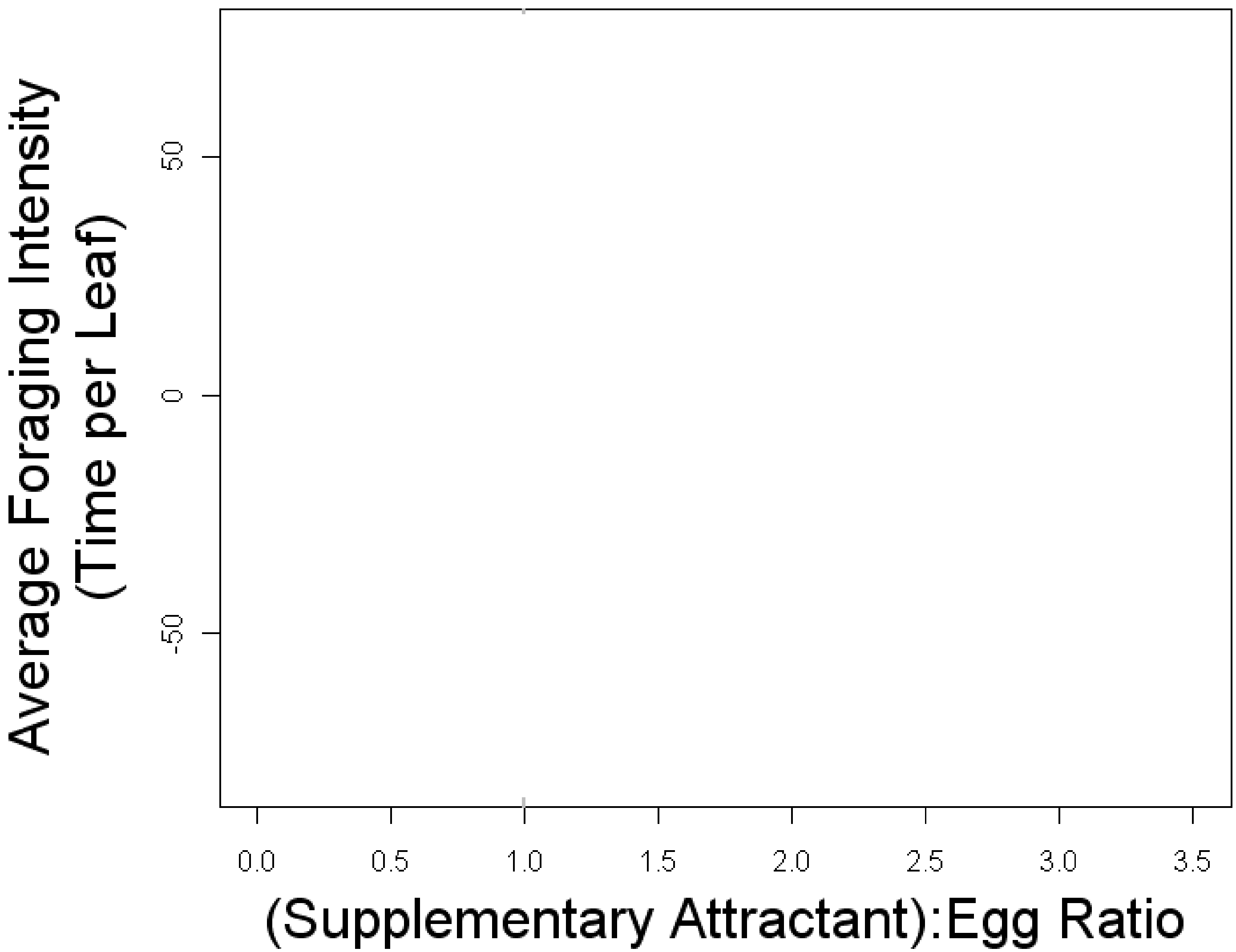
- Problem:
  - How to optimize the rate of wasp parasitism?
- One route:
  - Pheromonal attractant sprays (Lewis et al. 1972)

Pheromonal Control of Corn Earworms

- Problem:
  - Blanket coverage of the pheromone doesn't change parasitism much

Pheromonal Control of Corn Earworms

- (Likely) Answer:
  - Lacking an egg payoff, the wasps change their behaviour (Roitberg 2007)
  - *Habituation*
- Workaround: spray less attractant
  - Foraging models can determine how much



(For a given egg density, assuming fixed parasitoid density. This graph is (also) conceptual)

- BE can inform and optimize pest management strategies by providing evolutionary insights

Conservation

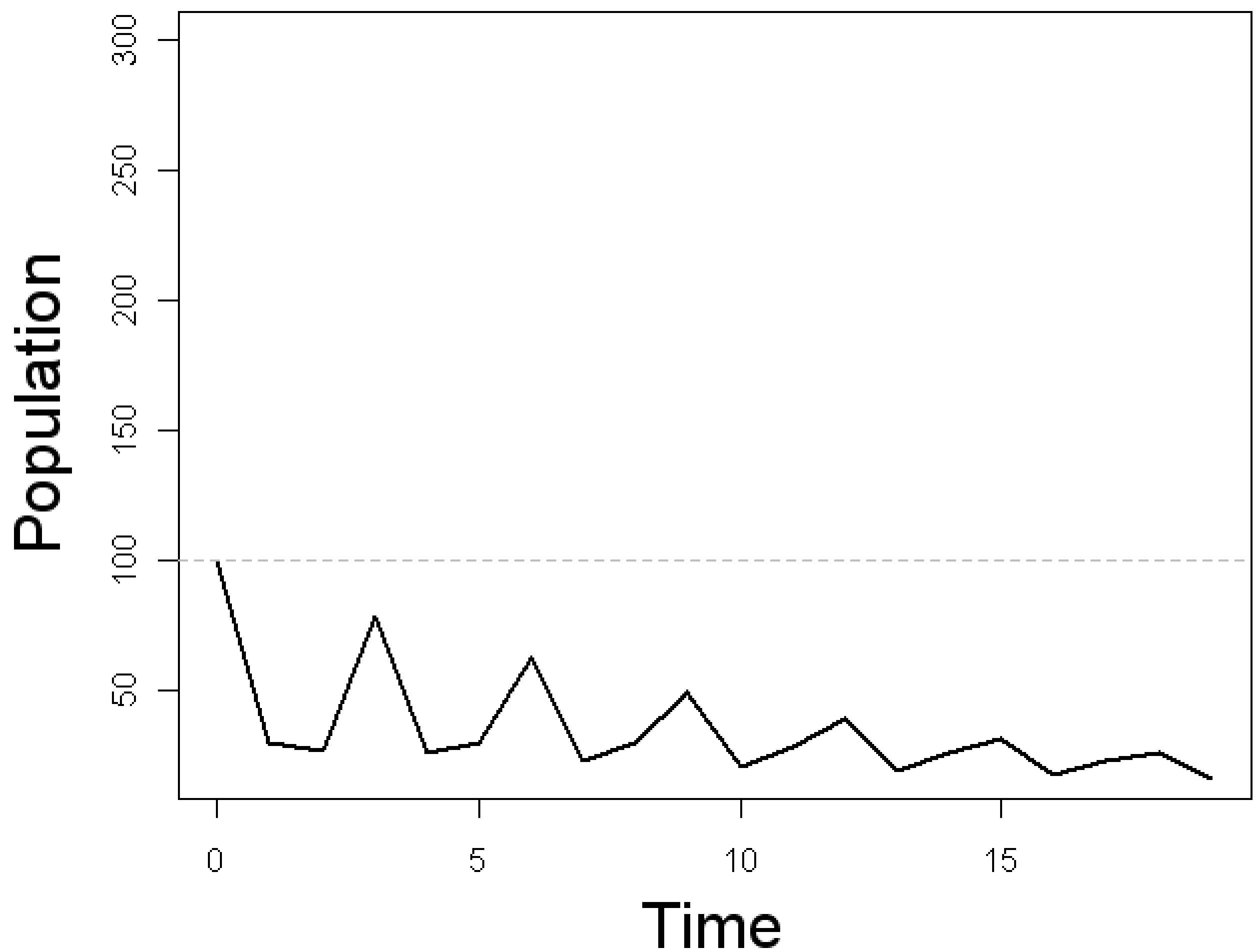
- Understanding behaviour important for many applications
  - Captive breeding
  - Re-introductions
  - Extinction forecasts/PVA

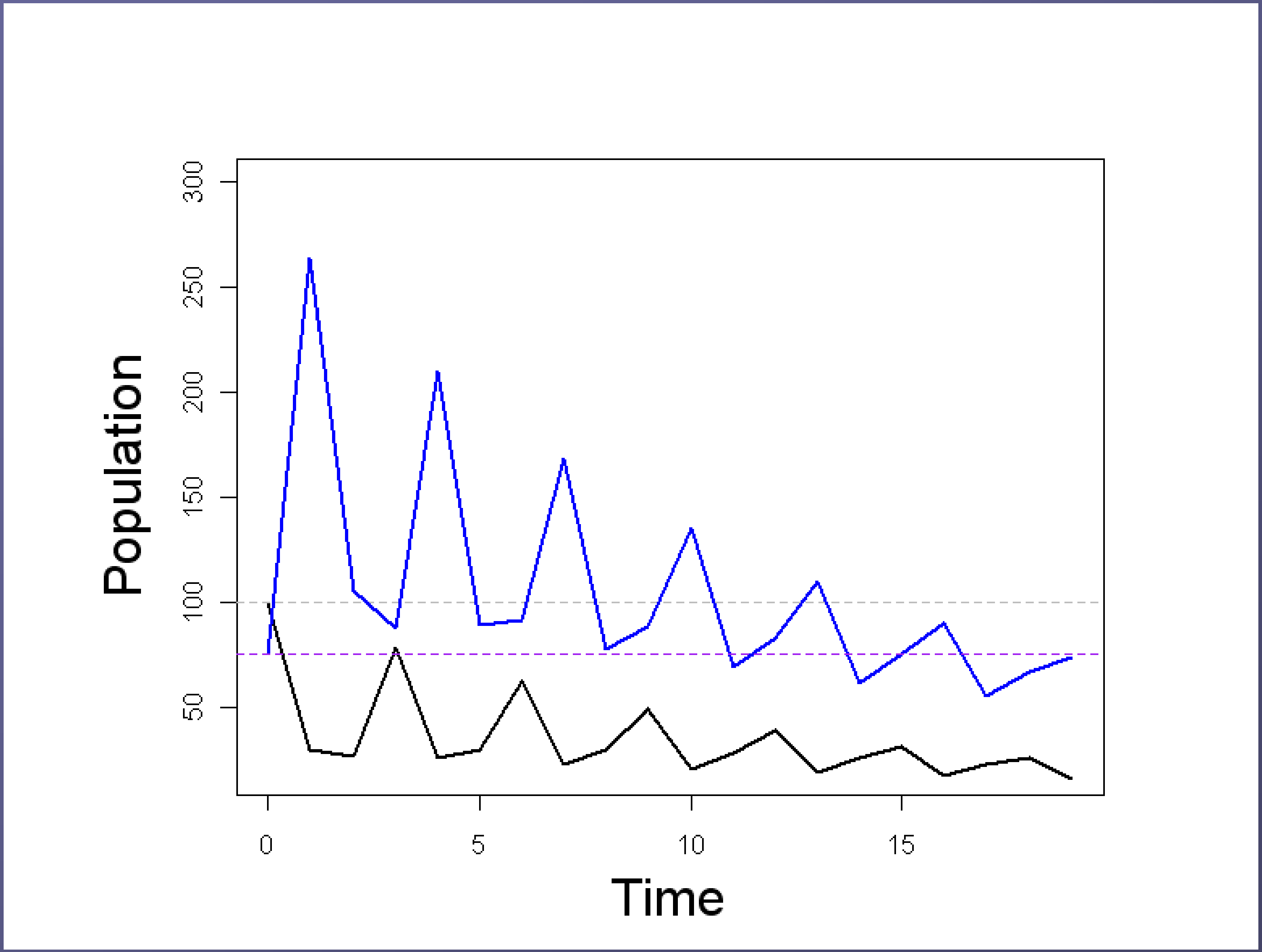
Conservation: Whooping Cranes

- "Captive" breeding
  - Cross-fostering by Sandhill Cranes
    - Mating problems
- Re-introduction
  - Ultralight aircraft migration training

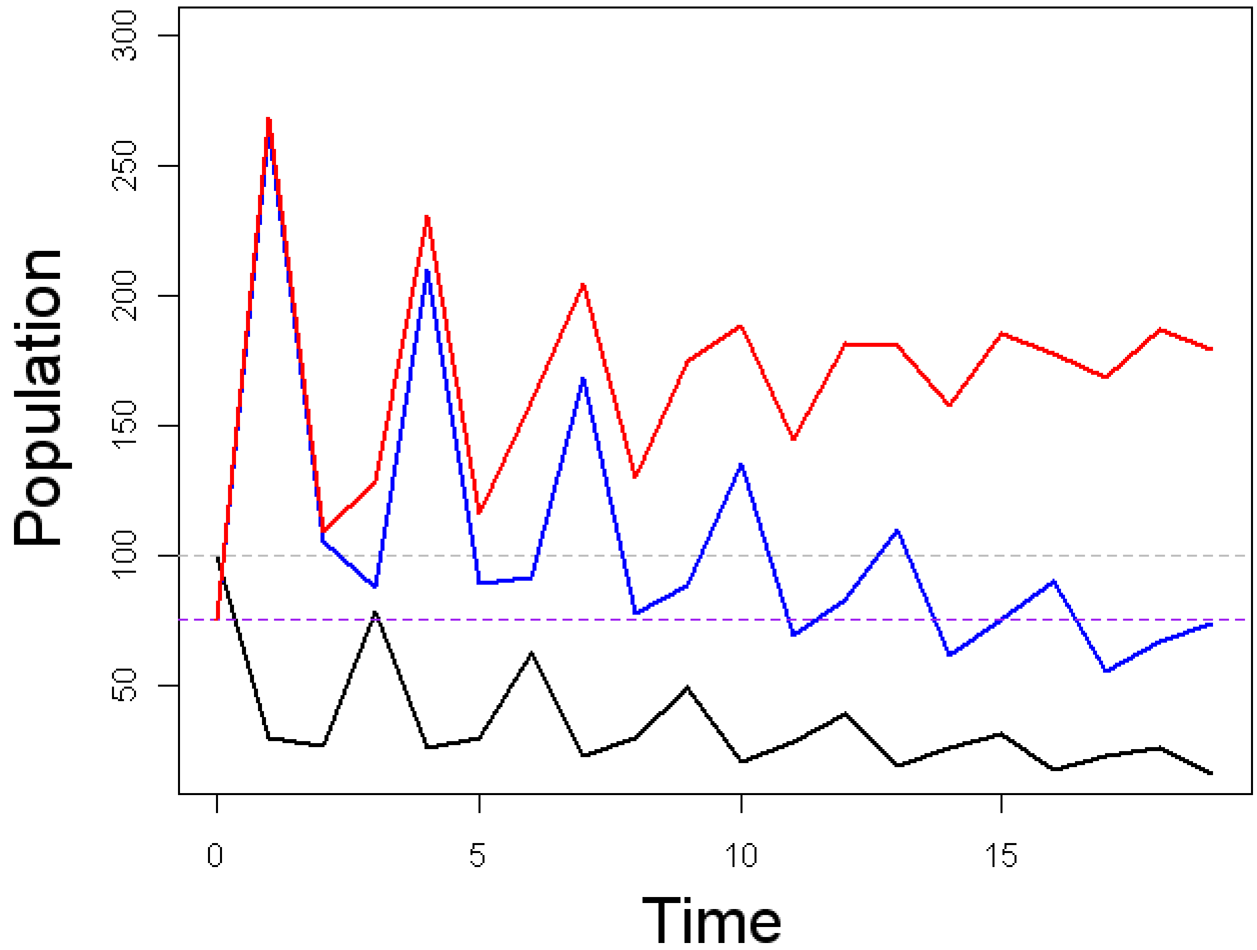
Conservation: Extinction Forecasts/PVA

- Estimate outcomes of multiple management scenarios
  - Can be data hungry
  - Individual-based models have emergent properties


Population
Time
300
250
200
150
100
50
0
5
10
15



Change the initial population size and age distribution



Double the recruitment (e.g. via assisted migration)

Conservation: Extinction Forecasts

- Now estimate consequences of different *behaviours*
  - How does competition for territory affect extinction probability? (Lopez-Sepulcre et al. 2009)

Seychelles Magpie Robins

- Establish breeding territories
- Nonbreeding subordinates:
  - Improve breeding success within years
  - Some territorial takeovers across years

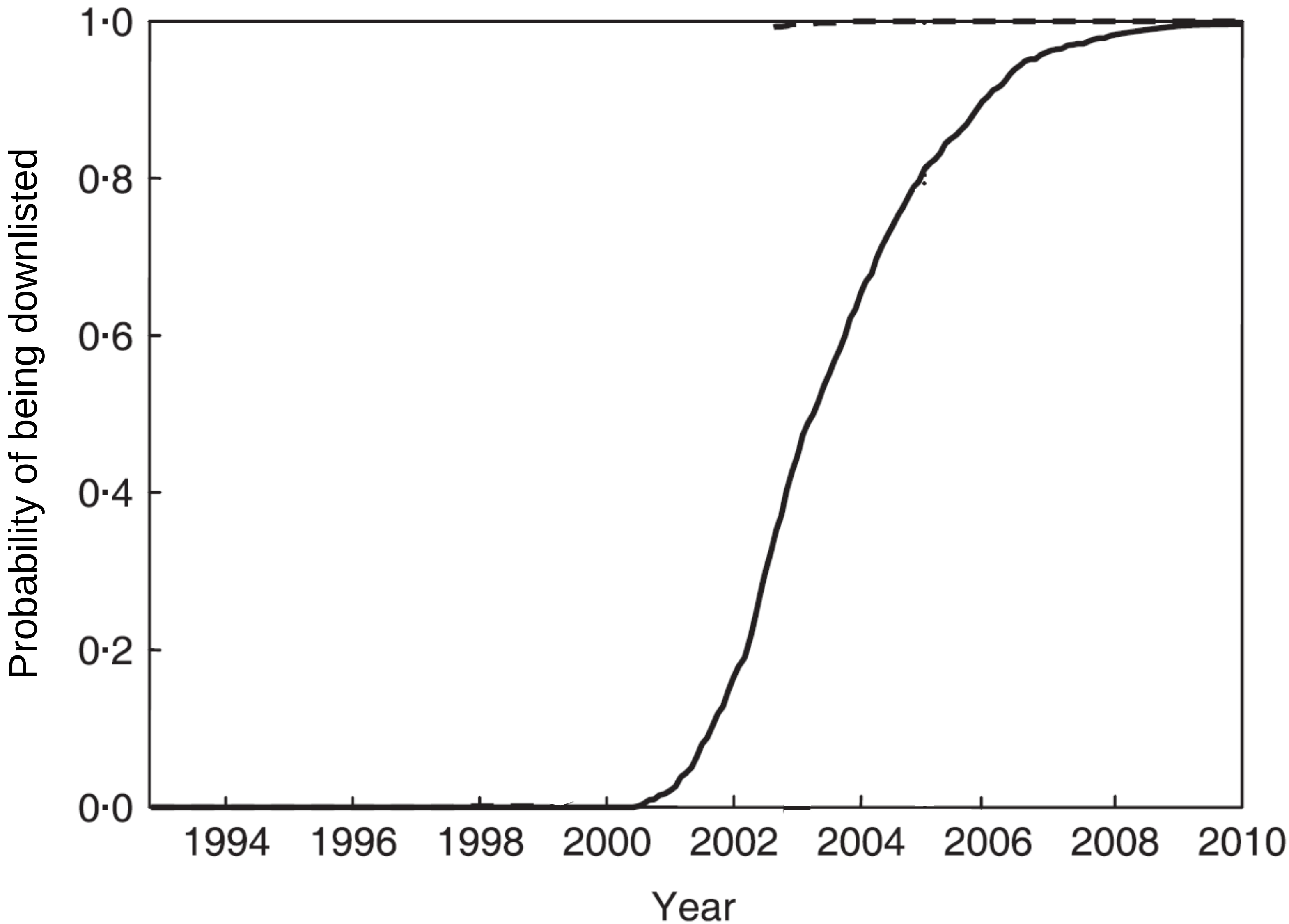
Seychelles Magpie Robins

- Simulate the population using a set of initial conditions behavioural “rules”
  - “If territory X features a breeder (no subordinates), fledging probability is 0.6
    - “Takeover probability is 0.05. If takeover occurs, fledging probability is 0.1”

Seychelles Magpie Robins

- Simulate the population using a set of initial conditions behavioural “rules”
  - “If territory X features a breeder and a subordinate, fledging probability is 0.8 (vs. 0.6)
    - “Takeover probability is 0.2 (vs 0.05). If takeover occurs, fledging probability is 0.1”

- Now consider two scenarios:
  - 1) Use these rules
  - 2) Eliminate territorial takeovers


Probability of being downlisted
1·0
0·8
0·6
0·4
0·2
0·0
1994
1996
1998
2000
2002
2004
2006
2008
2010
Year

Seychelles Robins: Implications

- Considering behavioural interactions can change our expectations for population recovery
- In this species, managing social interactions may improve recovery

- BE approaches can make realistic predictions about conservation management scenarios
  - Guide decision-making

Lecture notes (minus some of the pictures) at
http://leonardlab.biology.dal.ca -- “Teaching”