Population Viability Analysis and the Role of Head-starting for a northern Illinois Blanding's Turtle Population

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Background

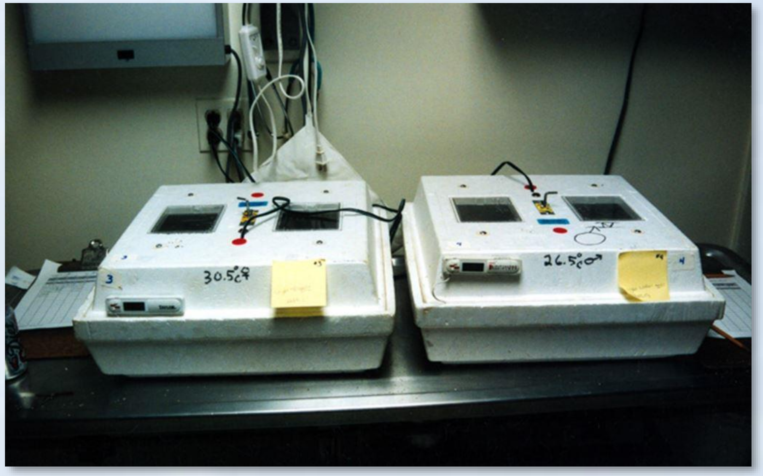
Blanding's Turtle (*Emydoidea blandingii*)

- Formerly common in northern Illinois, now only scattered populations
- Maintaining viable populations in Illinois is a priority for conservation efforts
- Head-starting and release programs have become a popular management tool

Background

Head-starting Programs

- Collection of eggs and captive rearing
- Alleviate mortality in younger age-class turtles
- Are benefits of head-starting sometimes overestimated?
- Worthwhile to evaluate the effectiveness of head-starting programs



Background

Head-starting Program

- Since 1997 have released over 2,200 Blanding's Turtles
- Moderate releases in late 1990's and early 2000's, larger releases in mid to late 2000's

Background

Release Site

- Over 4,000 acres in size
- 256 acres of dedicated nature preserve
- Interspersed prairie, forest, and wetland habitat

General Methods

- Used hoop traps baited with chopped fish to capture turtles
- Each Blanding's Turtle measured, notched, and PIT tagged for identification
- Combined our trapping data with long term monitoring data from the forest preserve district

Objectives

Evaluate effectiveness of the head-starting program

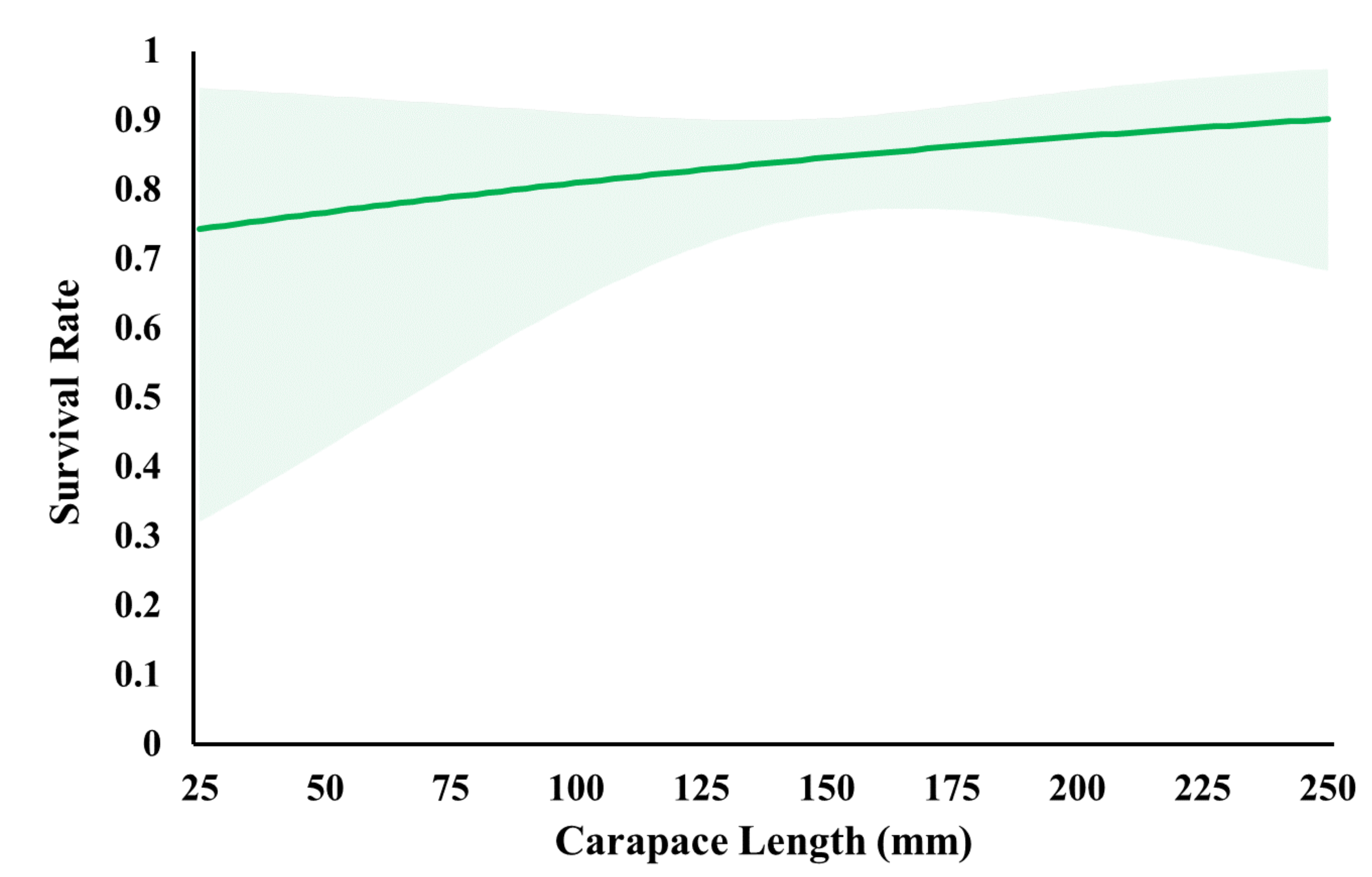
1) Survival Rates
2) Population Size
3) Population Viability Analysis

Head-start Survival - Analysis

Conducted Cormack-Jolly-Seber (CJS) survival analysis in MARK (White and Burnham, 1999)

- Used Akaike Information Criterion adjusted for small samples (AIC_C) to select best CJS model

- Global model: $\psi_{CL*Complex+t}$, $p_{CL*Complex+t}$



Survival rate as a function of Carapace Length

Adult Female Survival - Analysis

Used staggered entry Known Fates analysis in Rmark (R Core Team 2017; Laake, 2013)

- Created capture histories of radio-tracked females since 2000

- Censored intervals where the beginning or ending survival status not known

- Compared two survival models using AIC_C (Constant survival rate model and one containing a time effect)

Adult Female Survival - Results

Model	K	-2LL	AICc	ΔAIC_C	w_i
ψ	1	124.49	126.50	0.00	0.99
ψ_t	18	98.28	136.74	10.24	0.01

AIC_C Model Ranking for Known Fates Survival Analysis

- Top model indicated annual survival rate of 0.946 (CI=0.914-0.967)
- Overall, 17 adult females died from 2000-2018

Population Size - Analysis

Used the POPAN parameterization of the Jolly-Seber model in Rmark

- Created capture histories of all Blanding's Turtle captures since 2000
- Global model: ψ_t, p_t, $pent_t$, N
- Derived population size estimate

Population Size - Results

Year	N	se	LCL	UCL
2001	38	17.20	5	72
2002	49	11.33	27	71
2003	53	11.53	30	76
2004	46	10.04	26	65
2005	41	6.97	27	55
2006	50	8.28	34	66
2007	43	7.37	29	58
2008	67	14.71	38	96
2009	58	12.92	32	83
2010	84	15.44	54	114
2011	73	13.63	46	99
2012	75	14.86	46	104
2013	72	12.13	48	95
2014	94	16.09	62	125
2015	119	19.54	81	158
2016	124	16.24	92	156
2017	289	35.70	219	359
2018	306	23.63	260	352

Population size estimates and confidence intervals for top POPAN model

Population Viability Analysis

Population Viability Analysis (PVA) in program VORTEX (Lacy and Pollak, 2017)

- Reproductive parameters used: Age of maturity: 14 years
  Clutch frequency: 80.1 (SD=14.95)
  Clutch Size: 13.34 (SD=2.9)

- Mortality rates from CJS and Known Fates Analysis

- Initial population size from POPAN model

- Modelled varying mortality rates, head-starting effort, and environmental variation

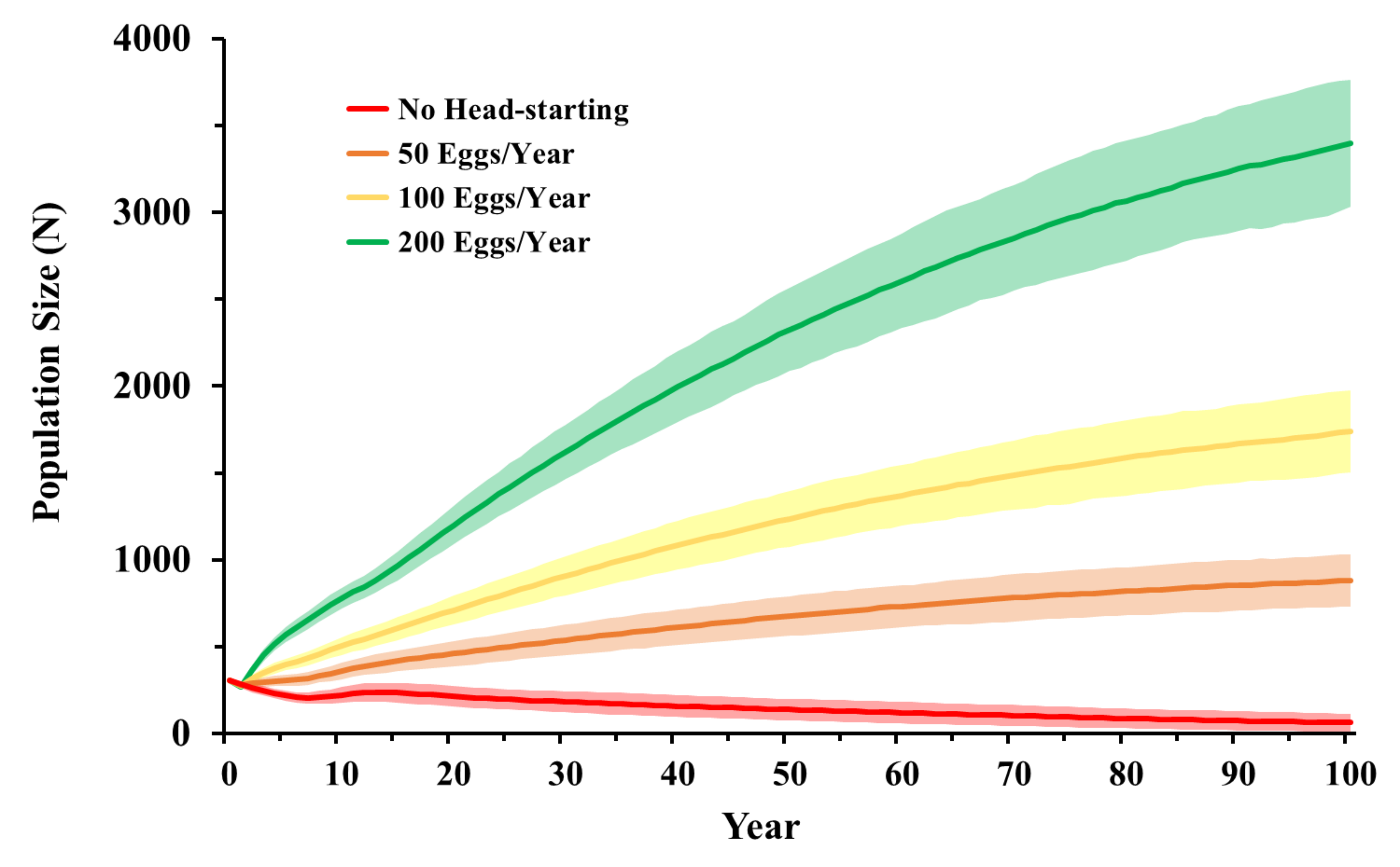
- Captive rearing scenarios assume eggs head-started to 1-year

- Ran scenarios for 100 years with 1000 iterations

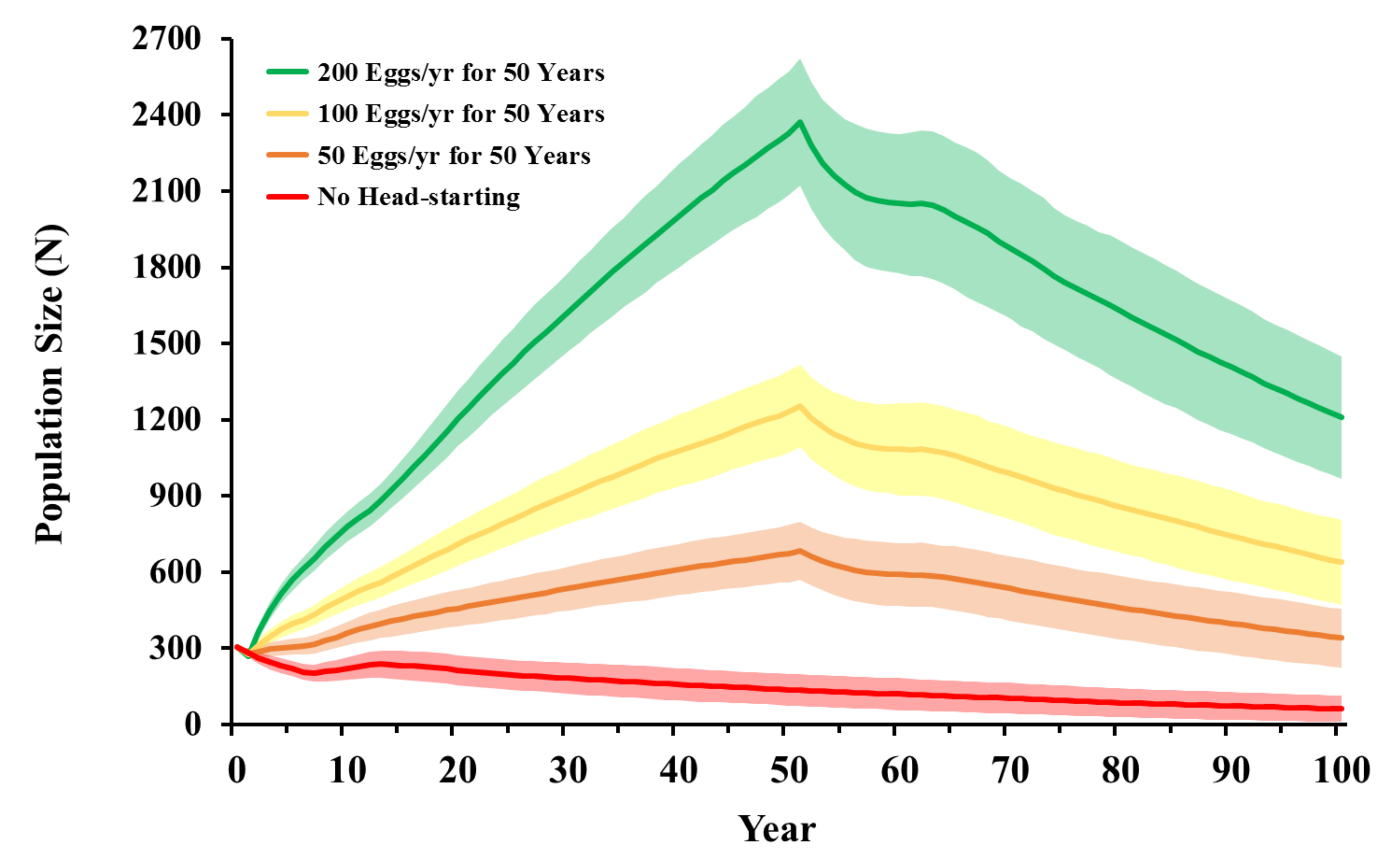
Population Viability Analysis

Scenarios:

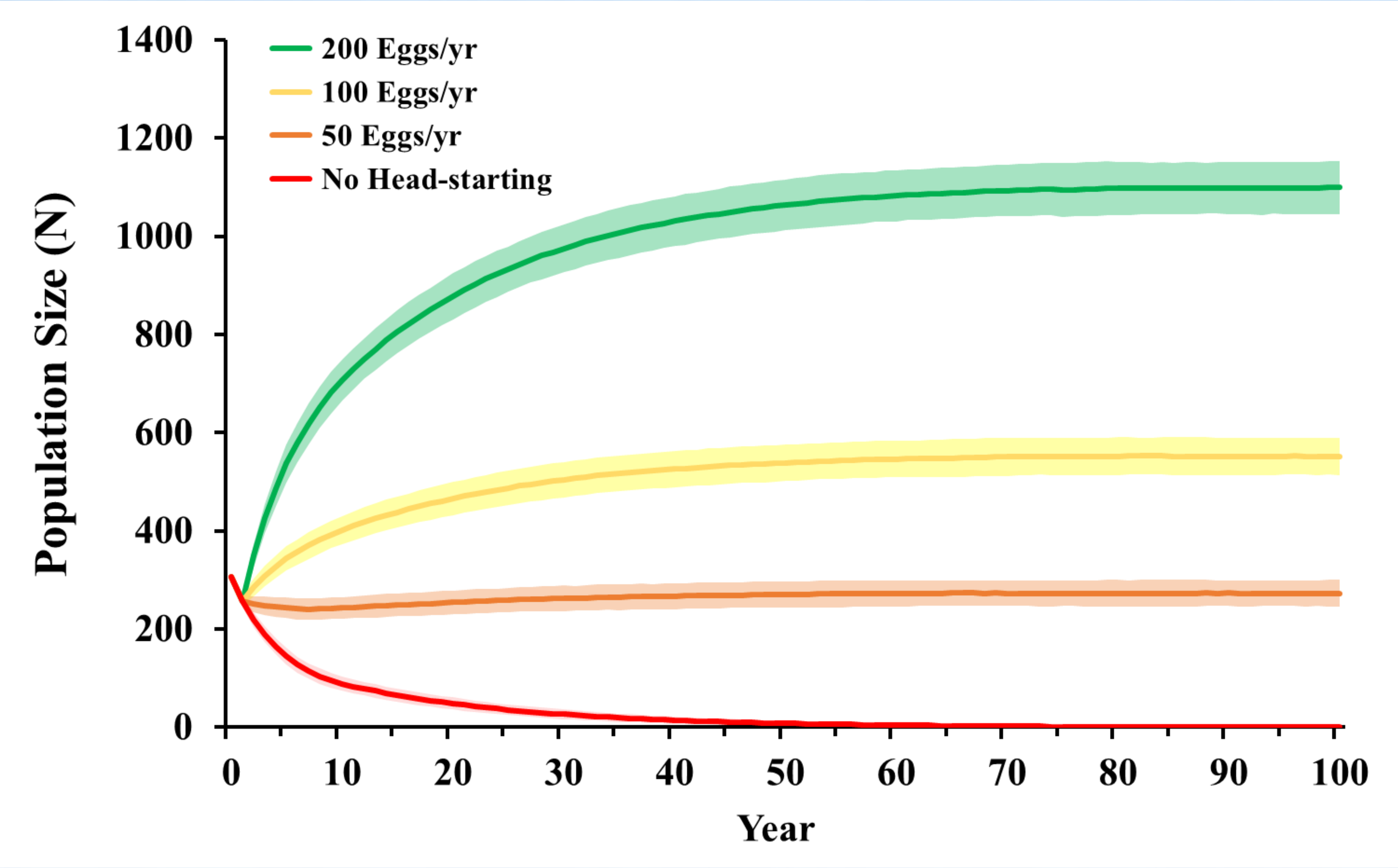
- Varied head-starting effort of 0, 50, 100, and 200 eggs/year
- Scenarios of head-starting for 50 or 100 years
- Head-starting coupled with increased juvenile mortality
- Default age 0-1 mortality of 92.8% (Glowacki and Kuhns, 2010), also modelled 100%, 85%, and 80%
- Scenarios of increased/decreased adult mortality
- Scenarios that included environmental variation (SD=5) in mortality rates



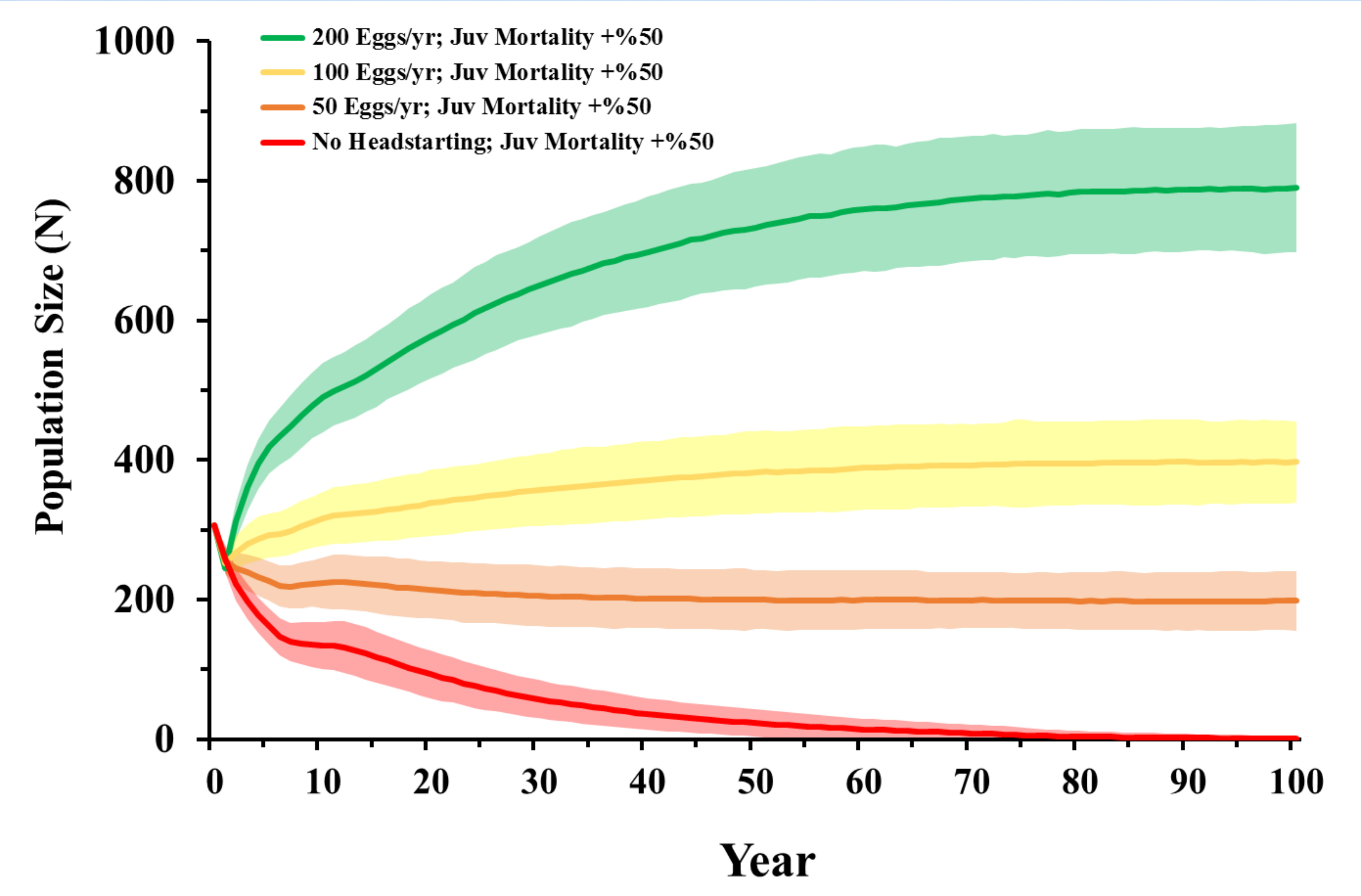
Projections assuming 92.8% Age 0-1 mortality



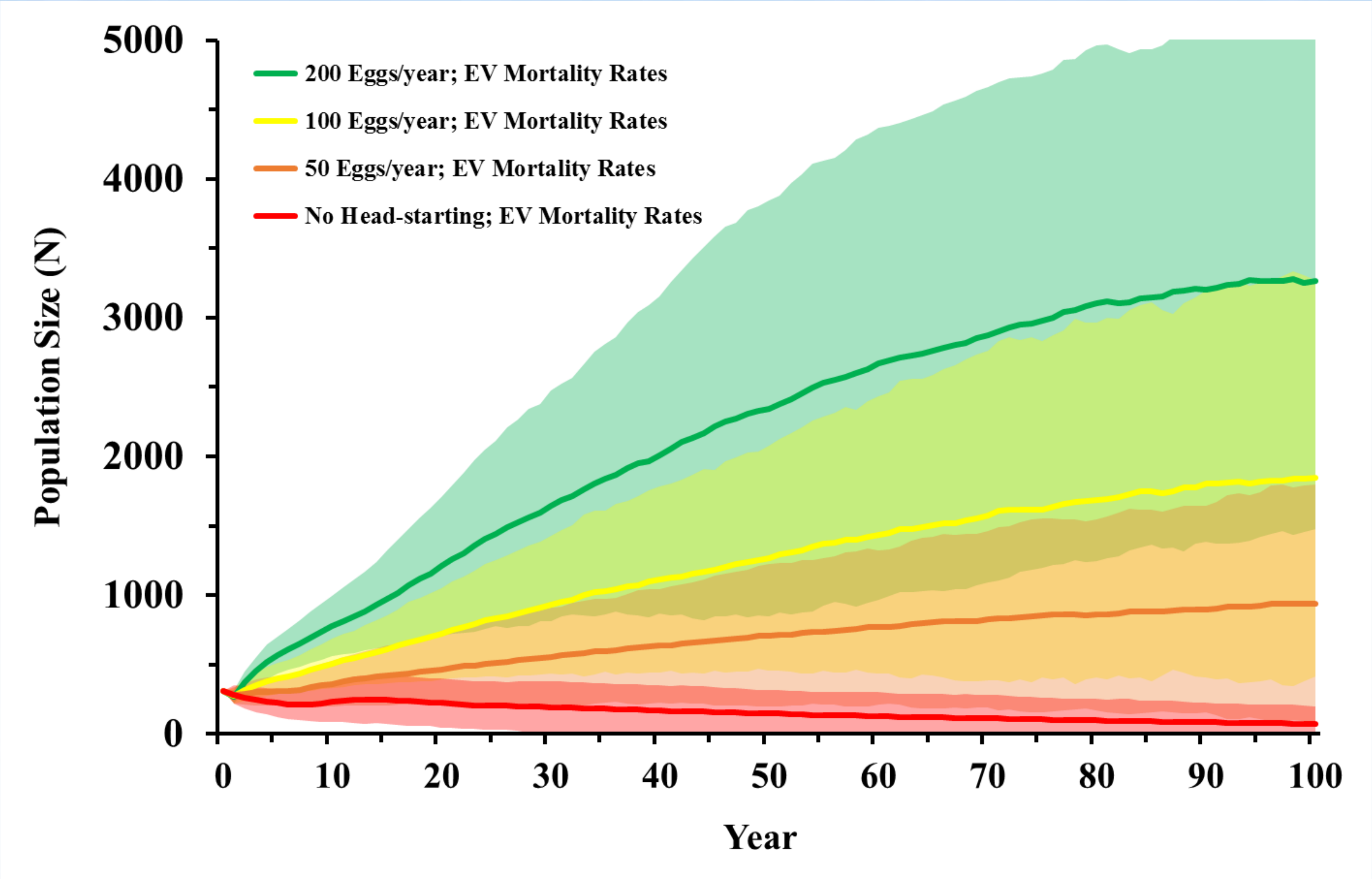
Projections assuming head-starting for 50 years



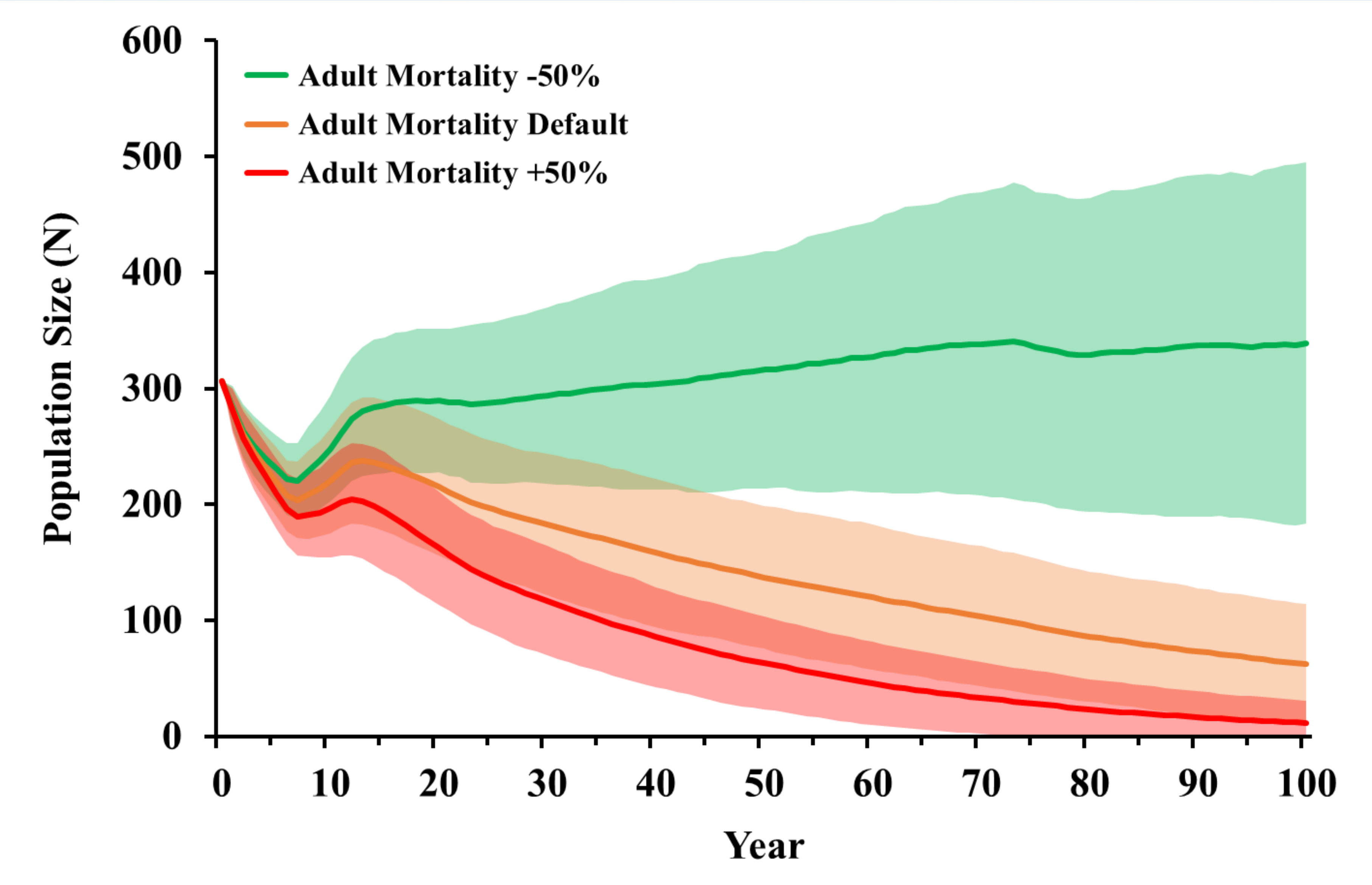
Projections assuming head-starting with no natural recruitment



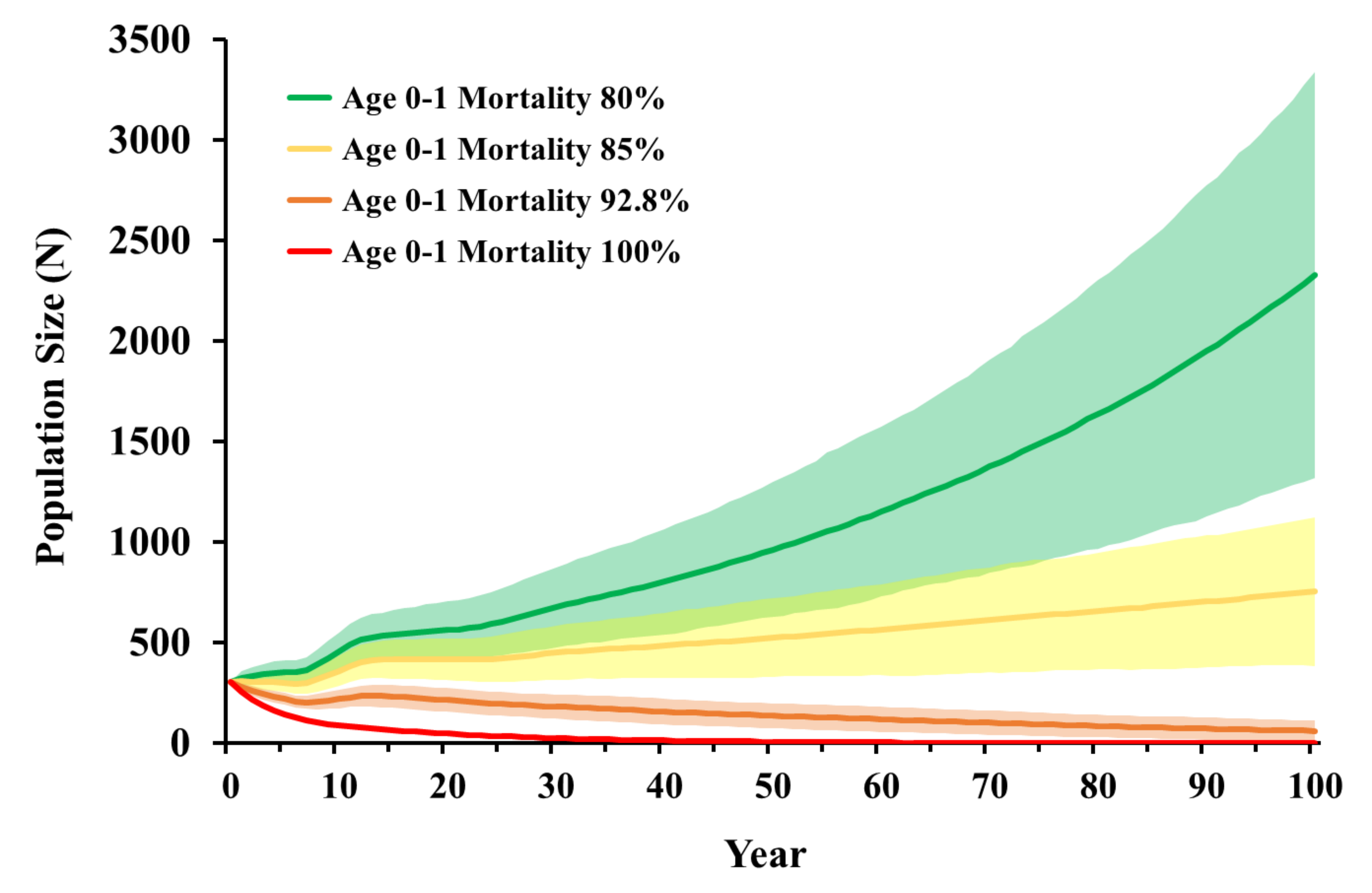
Projections of head-starting with increased juvenile mortality



Projections of head-starting with environmental variation in mortality rates



Projections with +/-50% adult mortality



Projections with variation in age 0-1 mortality rate

Population Viability Analysis

- Various outcomes depending on management
- Population will decline without head-starting and could go extinct if no natural recruitment occurring
- Maintaining high adult survival will be important regardless of other management practices
- Decreasing age 0-1 mortality would increase population growth rate, but more information on egg and hatchling mortality needed

Population Viability Analysis

- Head-starting should continue until management can demonstrate natural recruitment
- No risk of extinction within 100 years for any of the head-start scenarios
- Recommend head-starting at least 100 eggs/year to maintain or increase population size

Acknowledgements

Funding for this project was provided by the Forest Preserve District of DuPage County

We would also like to thank:

Additional Funding: Illinois State Toll Highway Authority

Field Assistance: Andrew Jesper, Taylor West, Stephanie Cosby, Josh Frushour

Organizations: University of Illinois at Urbana-Champaign and the Illinois Natural History Survey

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Questions?