Population Demographics and Conservation of Spotted Turtles in Maryland

Scott McDaniel[1], Hunter Howell[1,2], Richard Legere[1], Richard Seigel[2]

1. Susquehannock Wildlife Society, 1725 Trappe Church Road, Darlington, Maryland 21034
2. Department of Biological Sciences, Towson University, 8000 York Road, Towson, Maryland 21252-0001; Email: (RAS) rseigel@towson.edu

Spotted Turtles in MD

- Little published research on any population(s) in MD
  - See Ward et al. 1976
  - Unpublished studies from central MD and western MD
- Obvious need to monitor the largest populations to describe population trends and conservation concerns
- Were there large populations left?
  - Were they declining?
  - What was/is impacting their populations?

Objectives and Deliverables

1. Use Mark/Recapture to estimate basic demographic parameters
2. Produce a population viability analysis (PVA) to predict future population trajectory
3. Utilize a long-term data set to examine changes in demographic parameters and abundance over a 30 year time scale
4. Analyze the efficacy of mitigation practices using a sensitivity analysis and PVA

Methods: Mark-Recapture

1. Used collapsible mesh-minnow traps (PROMAR) to sample spotted turtles throughout the active season from 2014-2017
2. Marked individuals and collected basic morphometrics
3. Used open population models (POPAN formulation of the Cormack-Jolly-Seber) in Program MARK to estimate basic demographic parameters (e.g. survivorship and population size).

Howell et al., 2016. Herpetological Review

Methods: PVA and Sensitivity Analysis

1. Used Program VORTEX to produce a PVA for 150 years into the future
2. Took parameter values that we couldn't estimate at our site from the literature
3. Included higher and lower values for all parameters taken from the literature (sensitivity analysis)

Parameter	Value	Source
Number of iterations	1,500	
Breeding structure	Polygamous	Ernst and Lovich (2009); Beaudry et al. (2008)
Age at maturity	10	Ernst (1970); Ernst and Zug (1994)
Lifespan	75	See Litzgus (2006)
Clutch frequency	1 clutch per yr	Ernst and Zug (1994); Wilson (1989)
Sex ratio at birth	1 : 1	Beaudry et al. (2008)
Proportion of females breeding	100% (SD = 0.15)	Litzgus and Brooks (1998) recorded 52–61% of females each yr were gravid. Beaudry et al. (2008) recorded 100% of females each yr were gravid.
Mate monopolization	100%	
Mean clutch size	3.0 (SD = 0.5)	Ernst and Lovich (2009)
Sex ratio		
NWC	1 : 1 M : F	
SWC	1.2 : 1 M : F	From current study
Age distribution	Stable age based model	Program VORTEX; Beaudry et al. (2008)
Initial population size (NWC)	62	Estimated from current study using program MARK
Initial population size (SWC)	55	Estimated from current study using program MARK
Survivorship rates		
prehatching	58% (SD = 0.10)	Iverson (1991) based on Ernst (1970)
Age 1–3	45% (SD = 0.10)	Iverson (1991)
Age 3–6	70% (SD = 0.05)	
Age 6–7	80% (SD = 0.05)	Enneson and Litzgus (2008)
Age 8+	96.5% (SD = 0.01)	Current study
Time period	150 yr	Roughly 5 generations
Quasi-extinction level	8 individuals	Beaudry et al. (2008); Enneson and Litzgus (2009)
Dispersal	none	From current study
Inbreeding depression	none	Davy and Murphy (2014); Kuo and Janzen (2004); Mockford et al. (2005); Pittman et al. (2011)

Howell and Seigel, 2019. Journal of Herpetology

Female originally marked in 1988 (as an adult!)

Methods: Analysis of long-term data

1. Use data collected from 1987-1992 to produce historic estimates of population demographics and abundance
2. Same modeling procedure as for the current study

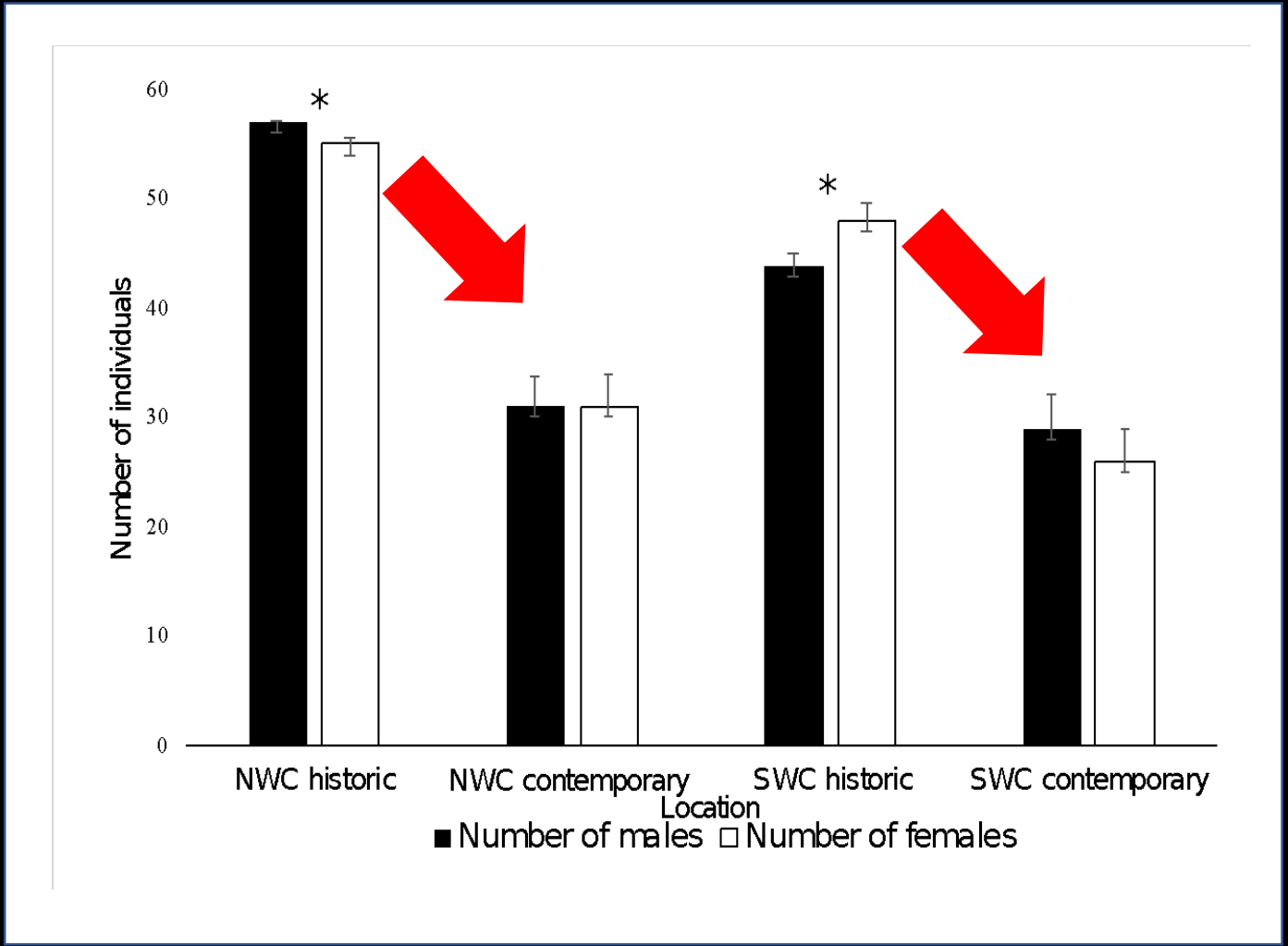
Study Site

- Main Study site = located in Central MD
  - Separated into North and South populations
  - North population = four vernal pools (2.28 ha)
  - South Population = three permanent wetlands and one vernal pool (1.35 ha)

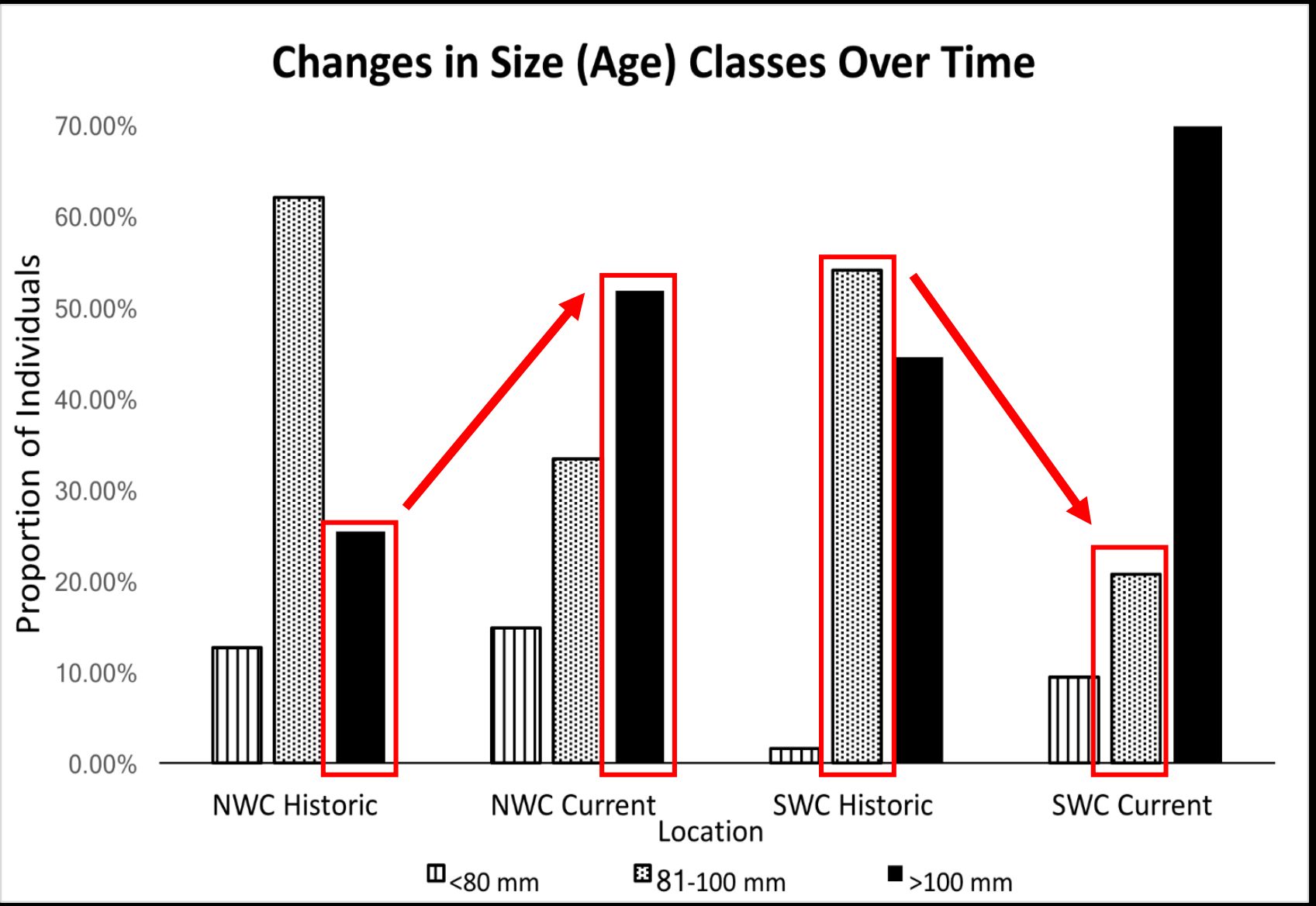
Results: Long-term Population Trends

- Historic Sampling = 225 individuals captured
  - Recapture Rate = 98.4% (243/247 captures in 1992)
- Current Sampling = 104 individuals captured
  - Recapture Rate = 93.0% (146/157 captures in 2017)

- Recorded a 49% decline in population size (a loss of 121 individuals)

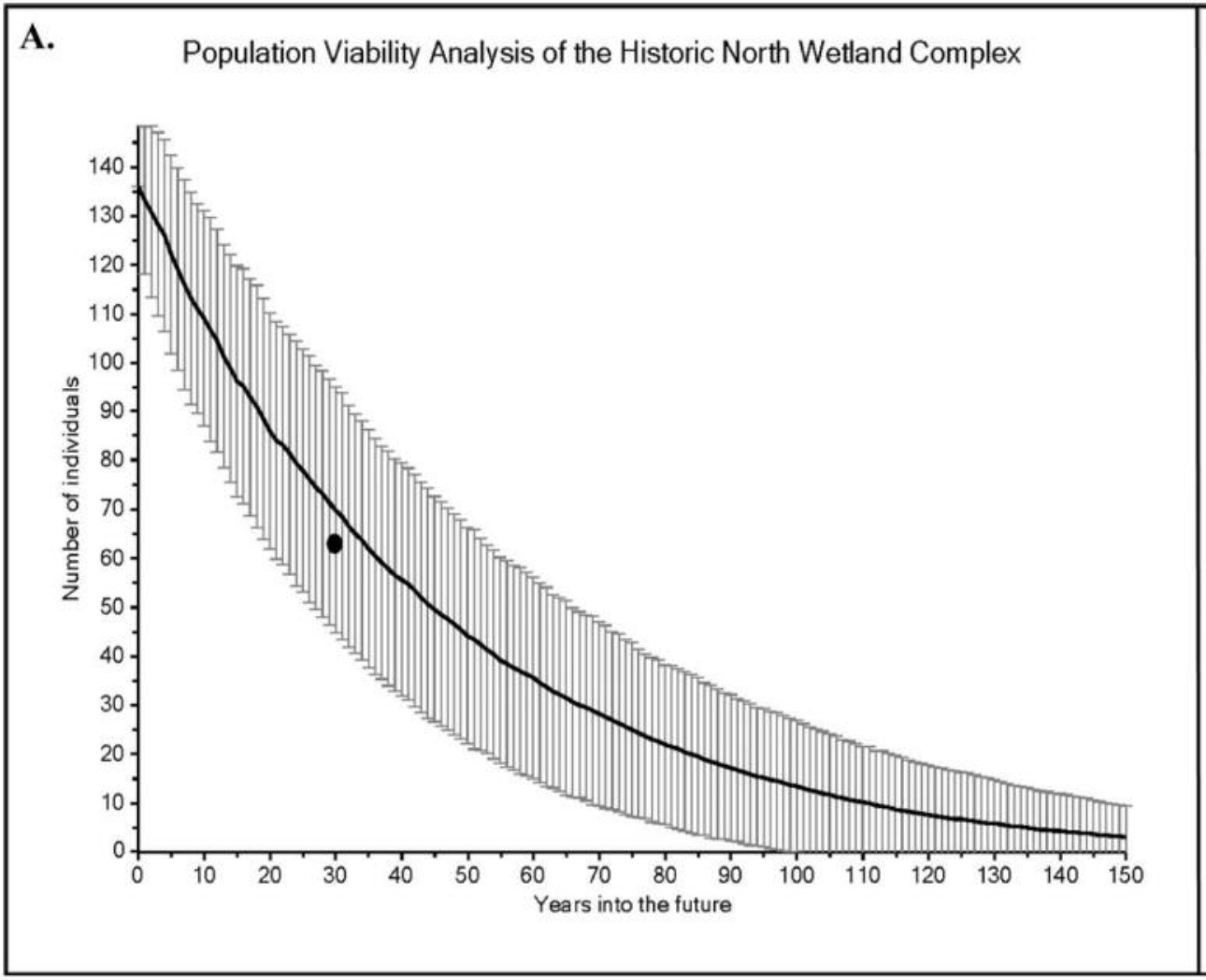


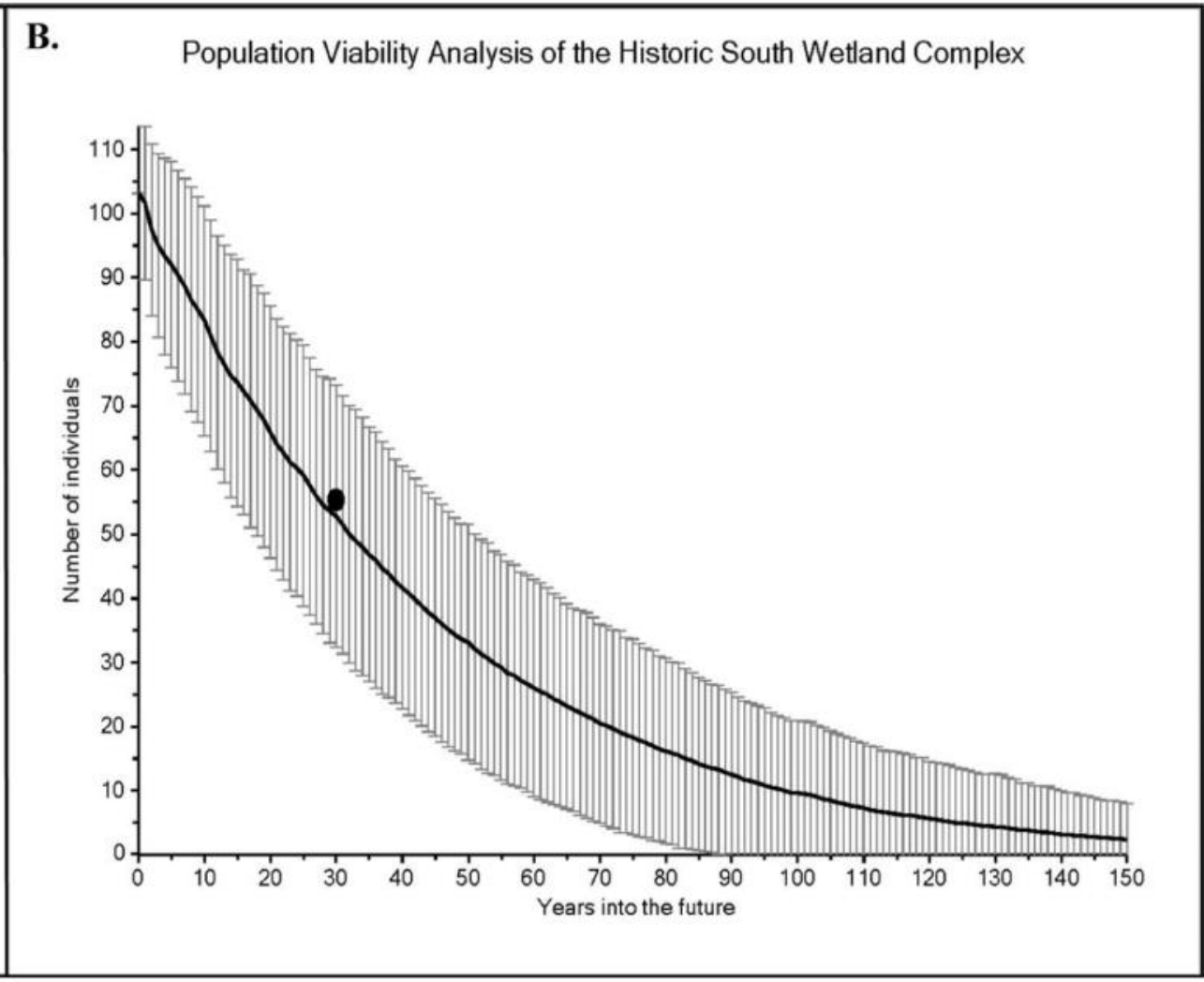
Howell et al., 2019. Copeia



Howell et al., 2019. Copeia

Accuracy of the PVA Model

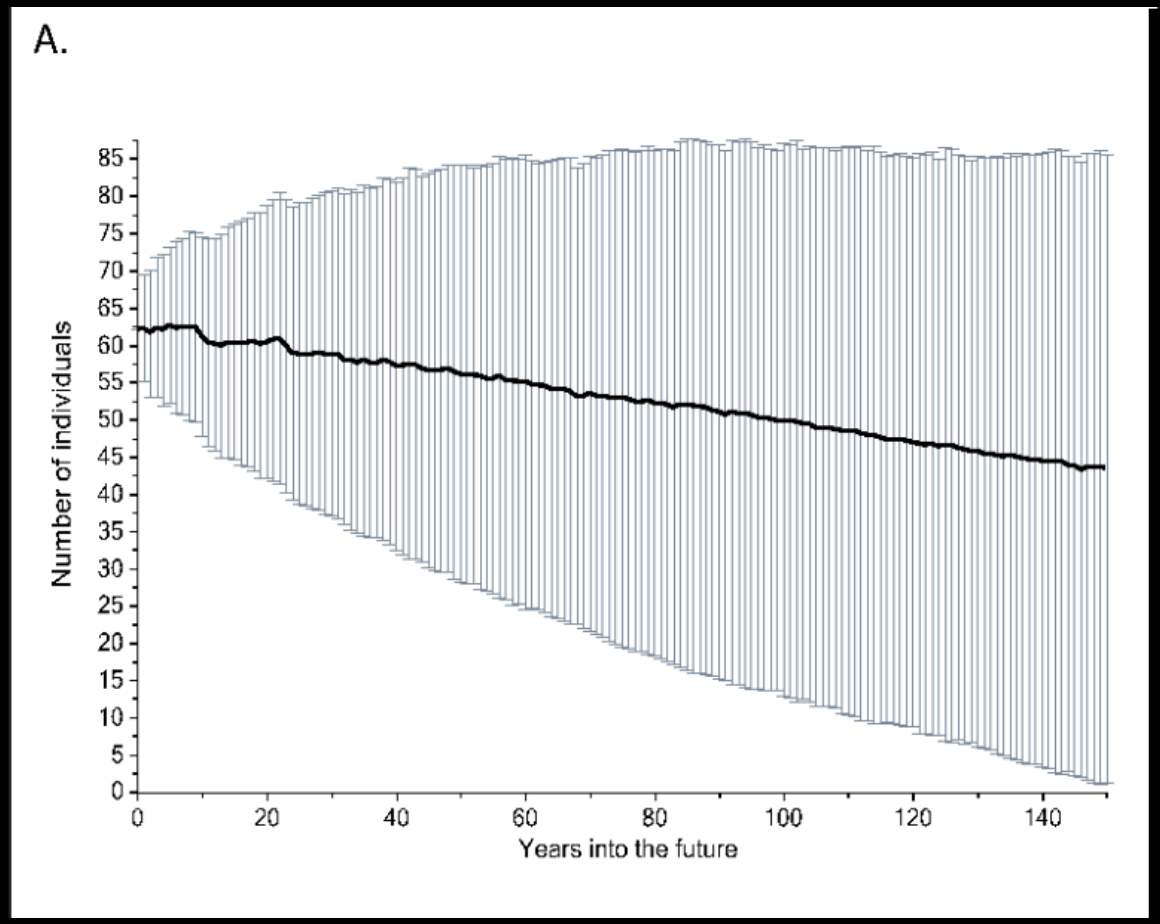




Howell et al., 2019. Copeia

What is causing declines within a protected area?

Road Mortality

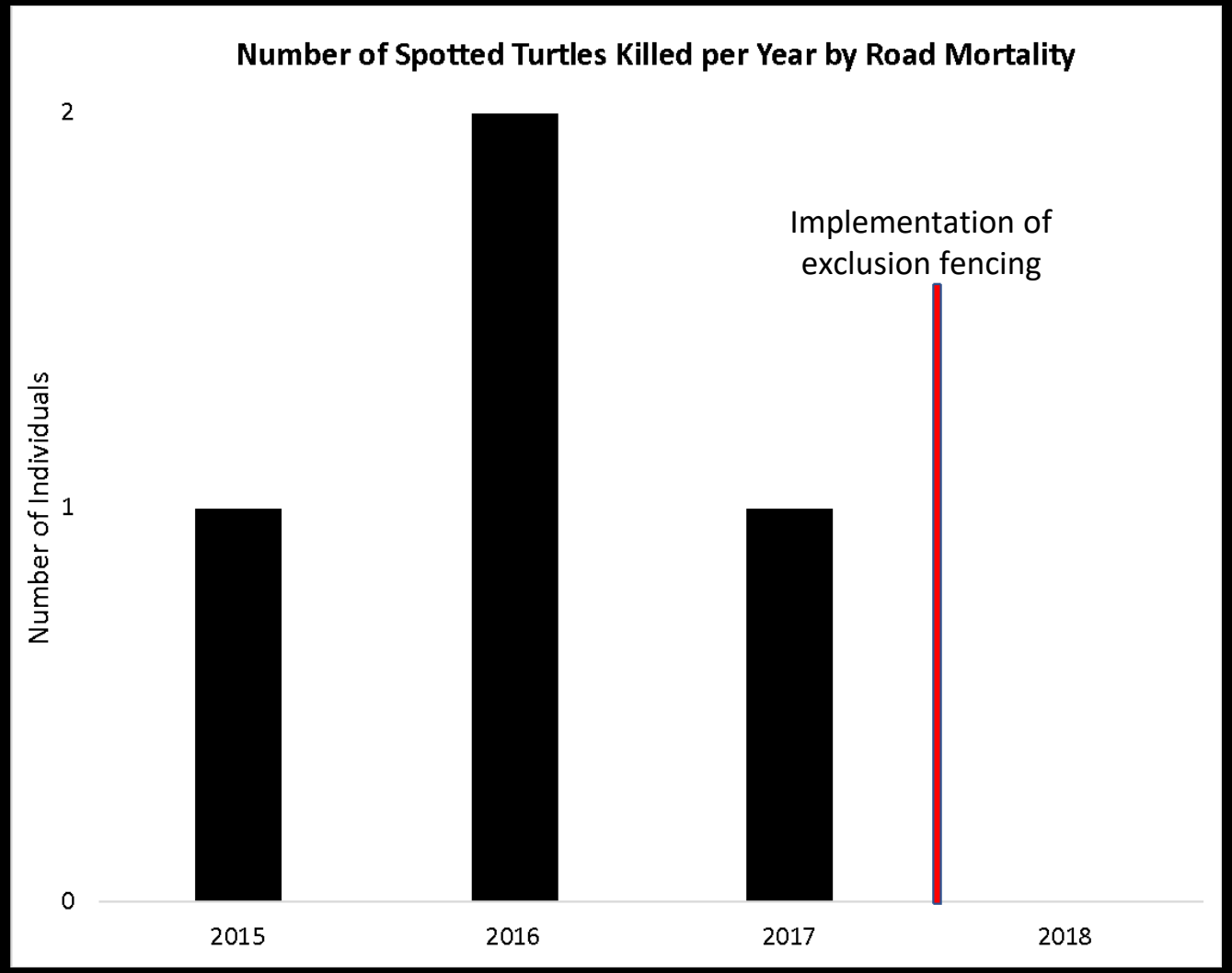


Use models produced from monitoring data to determine how road mortality is impacting the population

Howell and Seigel, 2019. Journal of Herpetology




Habitat Management



Effectiveness of the management strategies

Conclusions

1. Over a 30 year period, our population declined by 49% despite residing on protected land
2. Habitat management is critical – even within protected areas to reduce anthropogenic impacts and edge effects
3. Our PVA predicted a high >90% chance of quasi-extinction within 150 years given the current trajectory of the population
4. Management strategies, like exclusion fencing, have been successful at reducing adult mortality
5. Our PVA was accurately able to predict declines over a 30 year period – suggesting that our future predictions our accurate

Questions?

Papers Available on ResearchGate:
https://www.researchgate.net/profile/Hunter_Howell

@HunterH0well

- Facebook: SuskyWildlife
- Instagram: susquehannockwildlife
- Twitter: @SuskyWildlife
- YouTube: SuskyWildlifeSociety
- Website: www.susquehannockwildlife.org
- Email: contact@suskywildlife.org
- Mailing address: 1725 Trappe Church Rd. Darlington, MD 21034

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