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Variation in life history and population demography of massasauga rattlesnakes: What do we know and what do we need to learn?

Variation in life history and population demography of massasauga rattlesnakes: What do we know and what do we need to learn?

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Overview

- A comprehensive understanding of life history and demographic traits is essential in creating effective management plans for massasaugas
- Such data are especially important in creating population models and for manipulative programs (e.g., relocation)
- The better the data, the better the chance that we can create effective plans
- So, how good are our data? Where are the critical gaps?

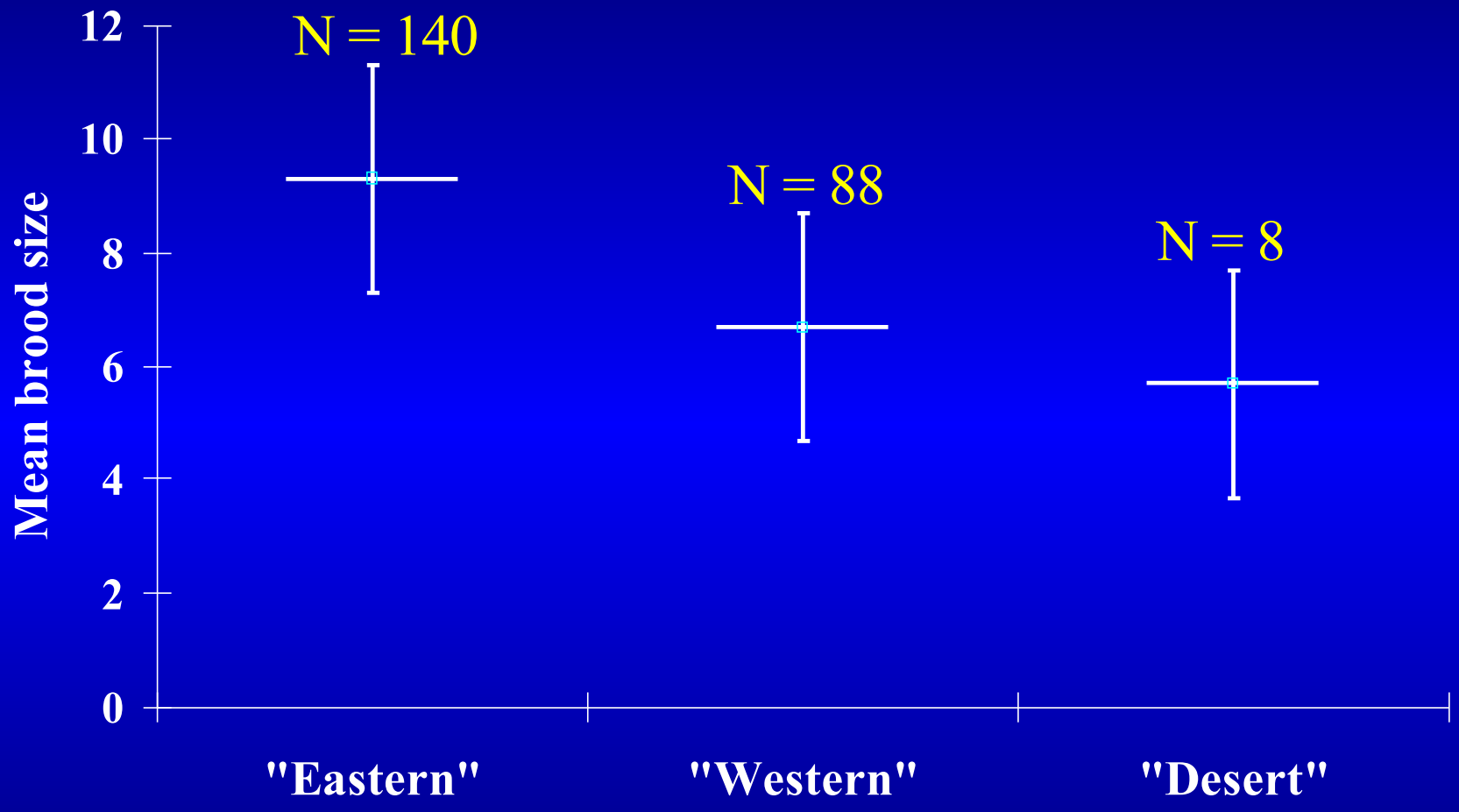
Essential data needed for life history and population models

- Brood size (relationship with maternal size)
- Reproductive frequency (individual based)
- Offspring size (relationship with brood size)
- Age at maturity (known age individuals)
- Adult survival (causes and key correlates)
- Juvenile/neonate survival (causes and key correlates)

Sources of variation

- Phenotypic plasticity (esp. resource-based)
- Temporal-stochastic (e.g., changes in weather conditions, predator abundance)
- Local adaptation
- Phylogenetic correlation

Variation in brood size among possible clades



Brood size data-unfiltered

E. Georgian Bay	11.0 (N = 60)	Jake Rouse (pers. comm.)
Pennsylvania	7.3 (N = 11)	Reinert (1981)
Wisconsin	11.1 (N = 58)	Keenlyne (1978)
Illinois	9.5 (N = 6)	Wright (1941)
Illinois	7.6 (N = 5)	Anton (1992)
NW Missouri	8.1 (N = 52)	Seigel (1986;1998; Pilgrim 2001)
Cent. Missouri	6.7 (N = 29)	Crabill & Seigel (unpubl)
Texas	5.3 (N = 7)	Greene & Oliver (1965)
Arizona/Colorado	5.3 (N = 6)	Goldberg & Holycross (1999)
Colorado	6.0 (N = 2)	Hobert et al (2004)

Brood size data-filtered for N = 10 or more

E. Georgian Bay	11.0 (N = 60)	Jake Rouse (pers. comm.)
Pennsylvania	7.3 (N = 11)	Reinert (1981)
Wisconsin	11.1 (N = 58)	Keenlyne (1978)
NW Missouri	8.1 (N = 52)	Seigel (1986,1998);Pilgrim 2001)
Cent. Missouri	6.7 (N = 29)	Crabill & Seigel (unpubl)

Brood size-filtered for published multi-year studies

NW Missouri-1981	6.33 (N = 9)	Seigel et al (1986)
NW Missouri-1982	6.55 (N = 14)	Seigel et al (1986)
NW Missouri-1993	4.80 (N = 5)	Seigel et al (1998)
NW Missouri-1996	10.3 (N = 24)	Pilgrim (2001)

Brood size data-filtered for multi-year AND N = 10 or more

NW Missouri-1982	6.55 (N = 14)	Seigel (1986)
NW Missouri-1996	10.3 (N = 24)	Pilgrim (2001)

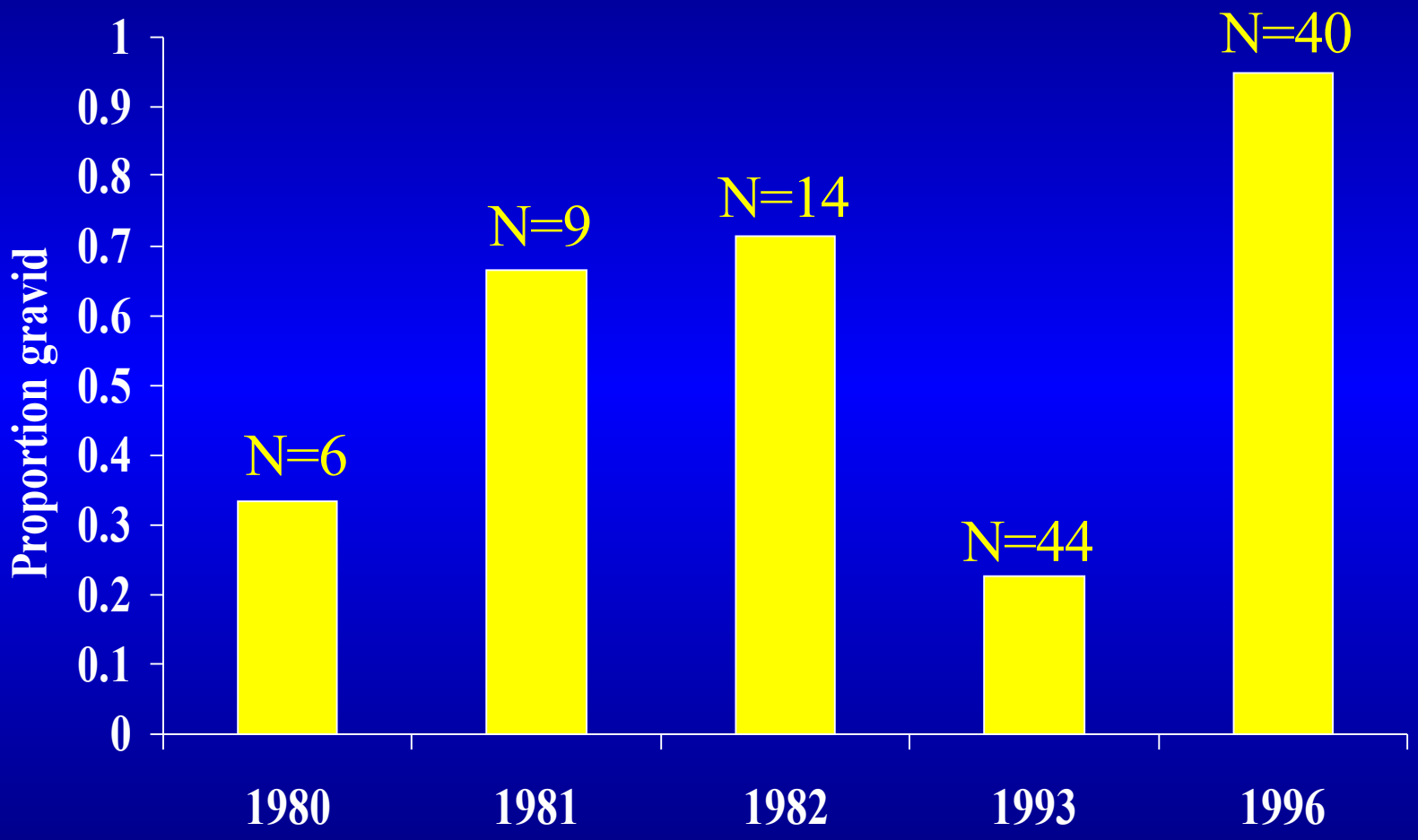
Offspring size data (SVL in mm unless noted)

E. Georgian Bay	195 (N=700)	Jake Rouse (pers. comm.)
Wainfleet Bog	225.4 (N=55)	Anne Yagi (pers. comm.)
Pennsylvania	235 TL (N=7)	Reinert (1981)
Wisconsin	220 SBR (N = 207)	Keenlyne (1978)
Illinois	224 TL (6 broods)	Wright (1941)
Illinois	226 (3 broods)	Anton (1992)
NW Missouri	252 (N = 16)	Seigel (1986)
Texas	224 TL (N = 7)	Greene & Oliver (1965)
Arizona	168 (N = 4)	Goldberg & Holycross (1999)
Colorado	191 (N = 23)	Hobert et al (2004)

Reproductive frequency

Locality	Percent gravid	Reproductive frequency
E. Georgian Bay	n/a	Varies:Biennial-triennial
Wainfleet Bog	42.8% (N = 14)	Five years data
Pennsylvania	52.0% (N = 23)	Biennial
Wisconsin	97% (N = 66)	Annual
NW Missouri	58.4% (N = 113)	Variable among years
Cent. Missouri	76.3% (N = 38)	Variable among years
Arizona/Colorado	15% (N = 46)	Longer than biennial

Yearly variation in proportion gravid in MO



Size at maturity

Adult mortality

Site	Activity Season	Overwinter
Bruce Peninsula	23%	21%
NW Missouri (SQ)	5.9%	6.2%
C. Missouri (SL)	22.2%	28.5%
C. Missouri (PSP)	10%	-----

Sources of variation

Source	Traits	Comments
Phenotypic plasticity	Brood size, RF, age at reproduction (?)	Limited data-well known in other snakes
Temporal-stochastic	Adult & juvenile mortality	More data likely available, not yet analyzed?
Local adaptation	Adult size? Offspring size?	Poorly understood; could be important for relocations
Phylogenetic correlation	Adult size? Offspring size?	No analyses attempted to date?

Conclusions

- Although data on massasauga life-history are not uncommon, sample sizes are often small and many studies are unpublished
- Sources of variation such as maternal size, yearly variation due to resource fluctuations, and local adaptation remain poorly known
- As a result, assessment of variation across the apparent clades is problematic, although "desert" massasaugas may show the greatest differences from other groups