



# A long-term (2000-2018) study of a large Adder population in northern Belgium: demography and implications for conservation

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## Detailed results can be found in:

- Bauwens D, Claus K, Mergeay J. 2018. Genotyping validates photo-identification by the head scale pattern in a large population of the European adder (*Vipera berus*). *Ecology and Evolution* 8:2985–2992. DOI: 10.1002/ece3.3917.
- Bauwens D, Claus K. 2018. Do newborn adders suffer mass mortality or do they venture into a collective hide-and-seek game? *Biological Journal of the Linnean Society* 124:99–112.
- Bauwens D, Claus K. 2019. Seasonal variation of mortality, detectability, and body condition in a population of the adder (*Vipera berus*). *Ecology and Evolution* 9:5821–5834. DOI: 10.1002/ece3.5166.
- Bauwens D, Claus K. 2019. Intermittent reproduction, mortality patterns and lifetime breeding frequency of females in a population of the adder (*Vipera berus*). *PeerJ* 7:e6912. DOI: 10.7717/peerj.6912.





# Outline:

- Where? What numbers?
- Habitats
- Demography
- Conservation implications





## An exceptional (?) Adder population ....

- very large (> 1000+ ind.)
- not vanishing (or even declining)
- *what are we doing at this meeting?*
- model for viable populations





# Adder demography & conservation



Isolated: nearest adders sites @  
18 km (tiny population), 110 km, 115 km & 130 km





# “Groot Schietveld”



- military domain
- restricted access
- 1570 ha  
(7.5 km x 2 km)
- heaths, moorland  
ponds, woods,  
pastures
- surroundings:  
agriculture &  
residential areas
- N133: busy road





# Adder observations

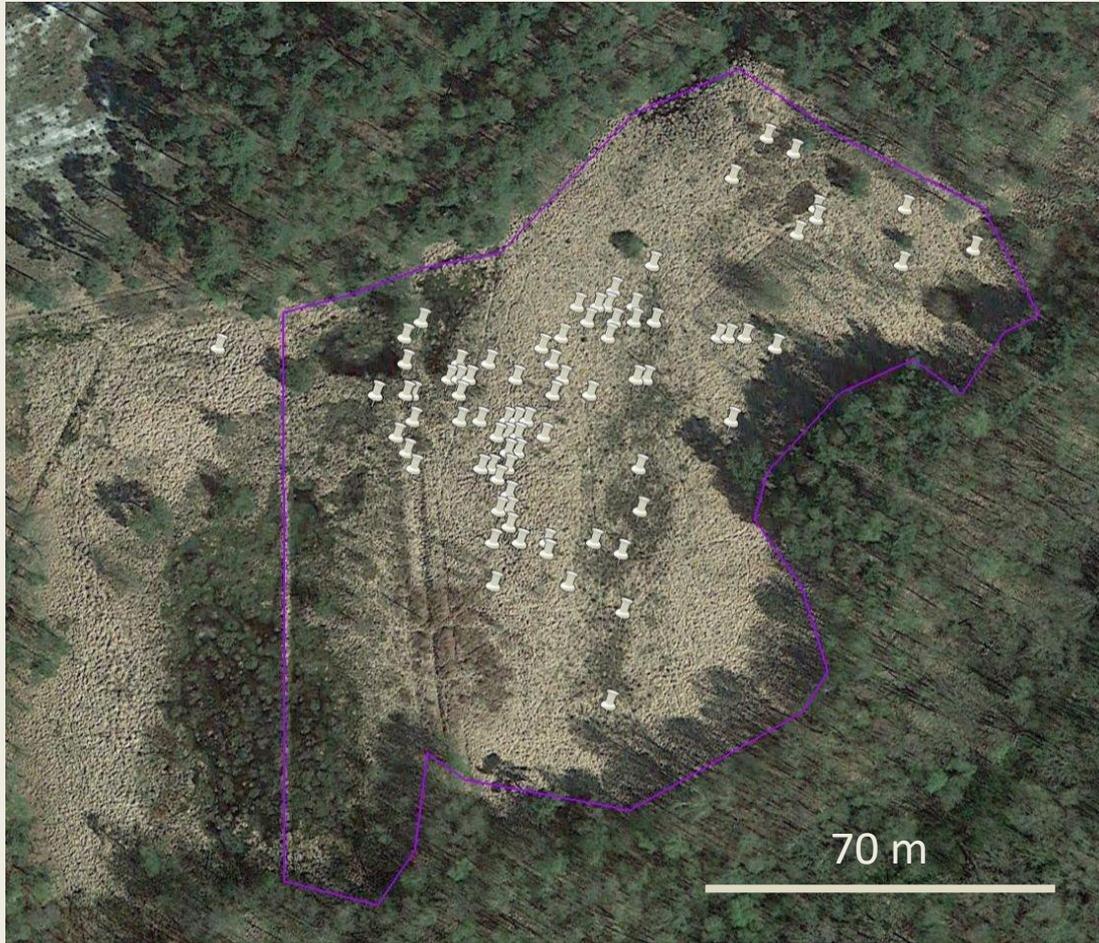


- Adders observed all over the domain
- local concentrations reflect our searches





## Locally very abundant



- Site “ZH”: 1,6 ha
- **2017:**  
25 ♂♂ ; 21 ♀♀ ;  
20 immatures  
(≠ individuals!)





## 16 study areas



- dispersed locations
- ≠ vegetation types
- represent total metapopulation
- hibernation (11) & feeding (5) areas
- ≈ 47 ha (<10%)





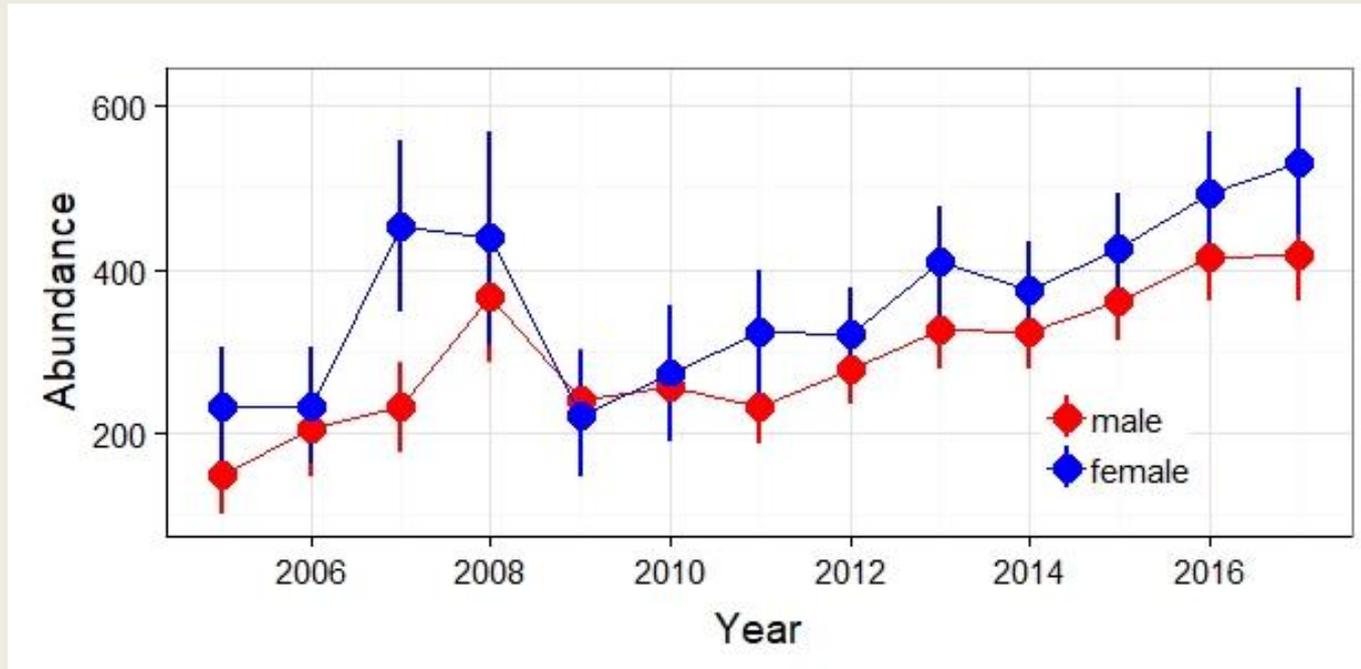
## Intensive population study

- Citizen science project (no funding)
- Long-term: 2000 – 2019; 1 – 6 persons
- Capture-mark-recapture; ID by photo of head scales
- SVL, mass, GPS-location, reproductive & shedding state, ...
- Year-round efforts (not just springtime)
- Both sexes, all age classes
- ~ 3540 person hours ( $\approx$  470 full time working days)
- ~ 7300 identifications; ~ 3500 individual adders





## Abundance adult adders



- $\approx 800$  adults +  $\geq 1000$  immatures
- on  $<10\%$  of  $\approx 1000$  ha suitable habitat
- Total population  $\approx x * 1000$  adders ( $x > 2$ )



*J. Zool., Lond.* (1971) 164, 373–418

**An ecological study of the viper *Vipera berus* in southern Britain**

IAN PRESTT

- “the viper occupies two distinct habitats, high, dry ground for winter hibernation and low-lying damp river meadows in summer”
- “a seasonal migration took place between the two habitats”
- “feeding takes place in a summer habitat”



# “Winter” habitats





- “Winter” habitats:
  - Heathlands
  - Hotspots for watching amazing adder behaviours (basking, dancing, mating, ...)
  - Focus of monitoring efforts
  - Focus of conservation and management actions
  - Occupied during winter + spring (all groups) and summer (breeding females)
  - Favourable thermal characteristics; low food availability





# “Feeding” (summer) habitats





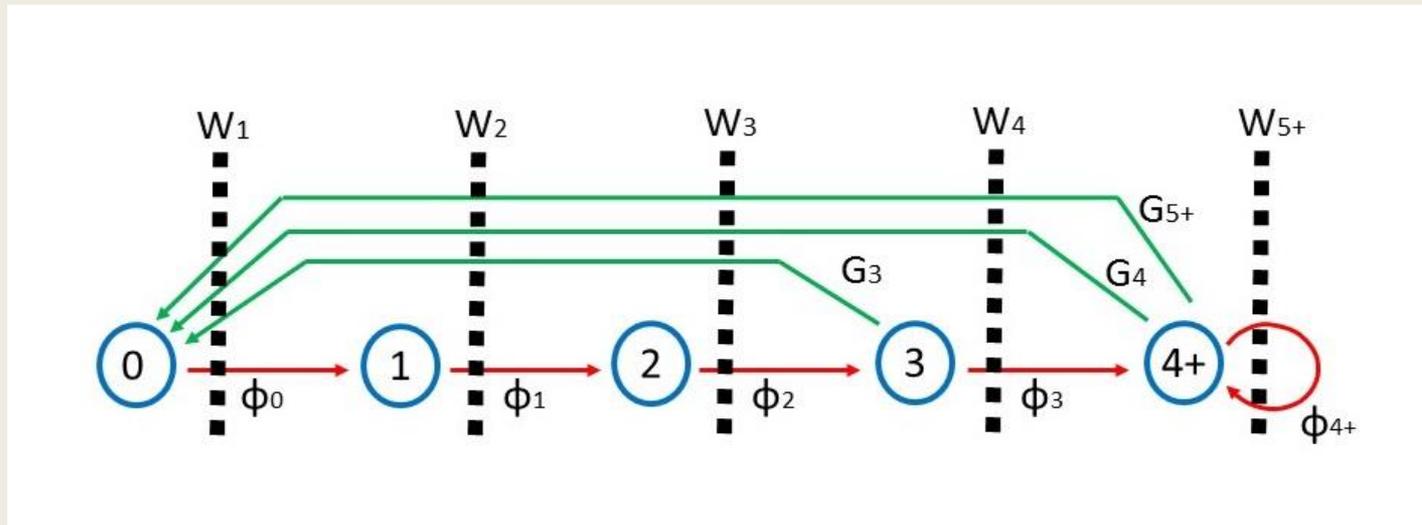
- “Feeding” (summer) habitats:
  - Wide range of habitat types
  - Adders behave secretively and are rarely seen
  - Little attention during monitoring
  - Little attention in conservation and management actions
  - Occupied by immatures and by adults in summer
    - large(st) part of their lifetime
  - High food availability: feeding grounds for all adders
    - essential for survival, growth and reproduction





# Demography & population model

- The adder life cycle



- Estimate vital rates: age-dependent survival probabilities and birth rates (and their among-year variation)





# Individual capture histories

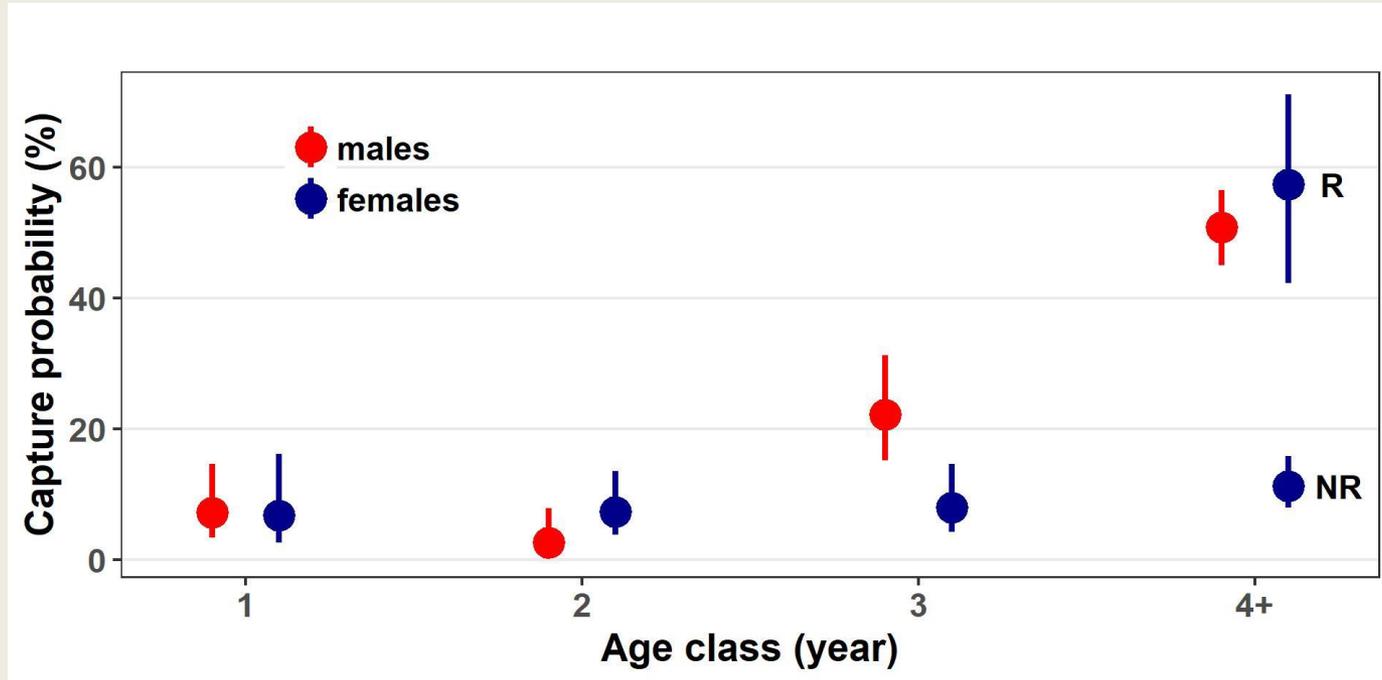
adder	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
05-124		1	1	-	1	-	1	1				
06-021			1	1	-	1	1	-	-	1		
06-124			1	1	1	-	-	1				
07-010				1	-	1	1	1	1	1	1	1
08-245					1	-	1	-	1	-	1	1

- Not all individuals present are captured yearly
- [Adders are shy, secretive and well-camouflaged]
- Estimate capture & survival probabilities





# Capture probabilities $\neq$ age/sex groups

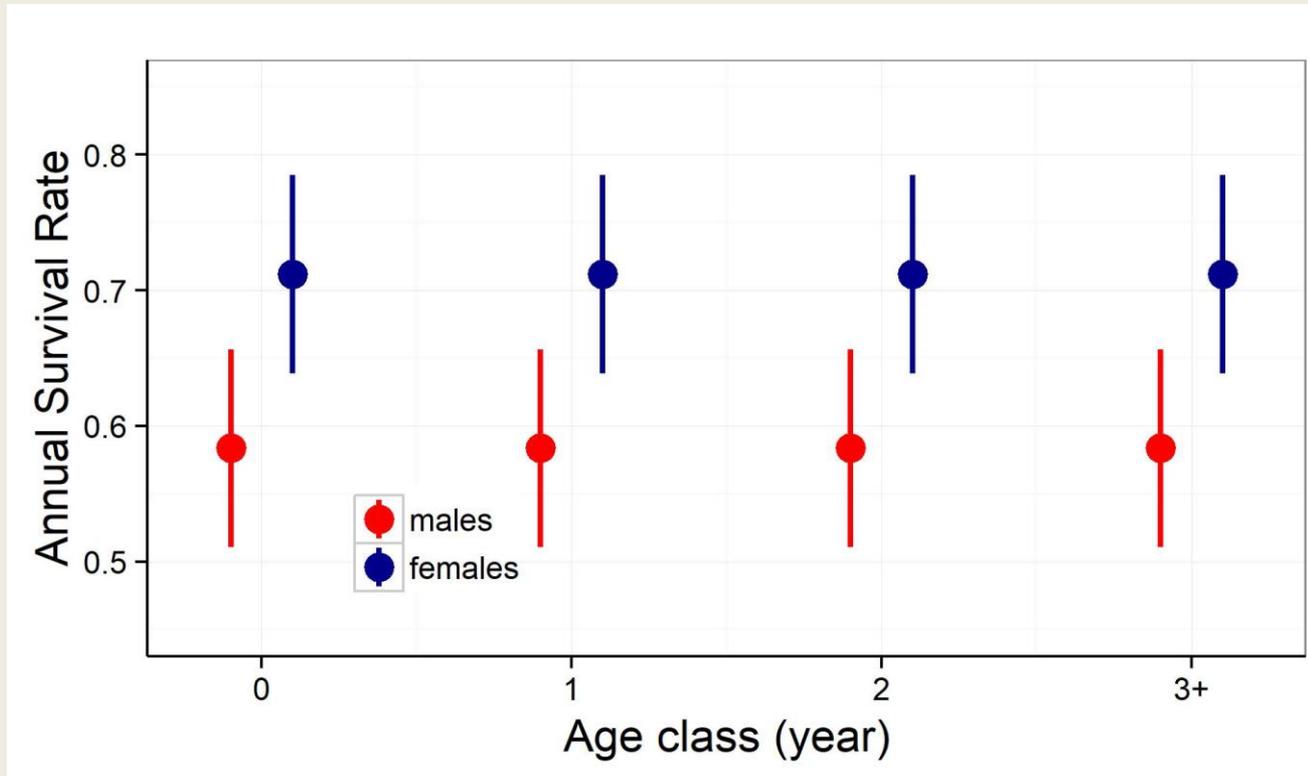


- Estimate survival probabilities “corrected” for varying capture probabilities (CJS-method)





# Annual survival probabilities

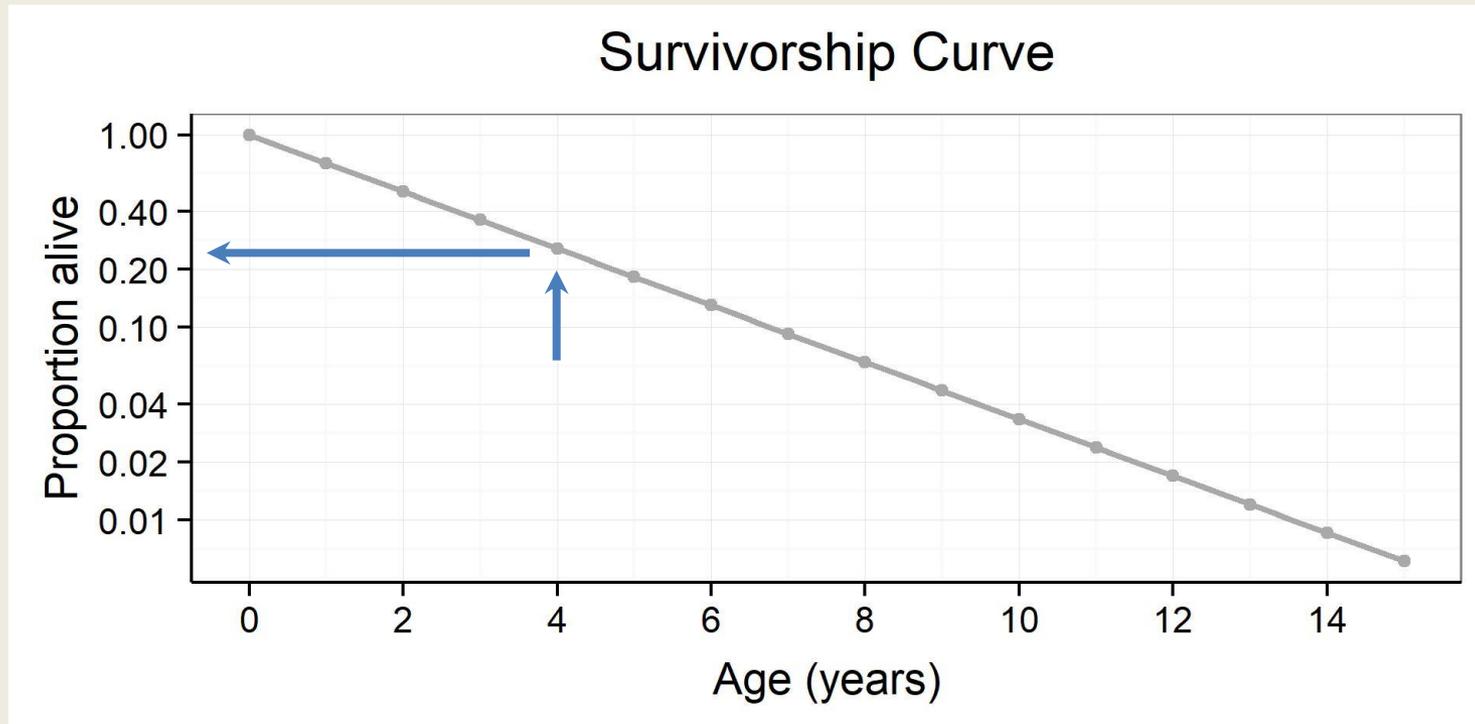


- **No** differences among age groups
- Global survival females (0,71) > males (0,59)





# Annual survival probabilities



- $\approx 22\%$  of newborn females survive to maturity (4 years)
- $\approx 5\%$  of females attain  $\geq 10$  years





## Birth rates

- Maturity (1st clutch) @ 3 yrs (15%) or 4 yrs (85%)
- Interval successive breeding events:  
2 yrs (63%), 3 yrs (29%), 1 yr (8%)
- Lifetime reproduction  $\approx$  1.3 clutches  
 $\approx$  **70%** mature females **breed only once!**
- Clutch size: 4 – 12 young





## Demographic (life-history) profile

- Delayed maturity (3 - 4 years)
- Low fecundity (4 – 12 young / litter)
- Short reproductive lifespan (1,3 litters)  
(confirming results obtained by the young T. Madsen & others)

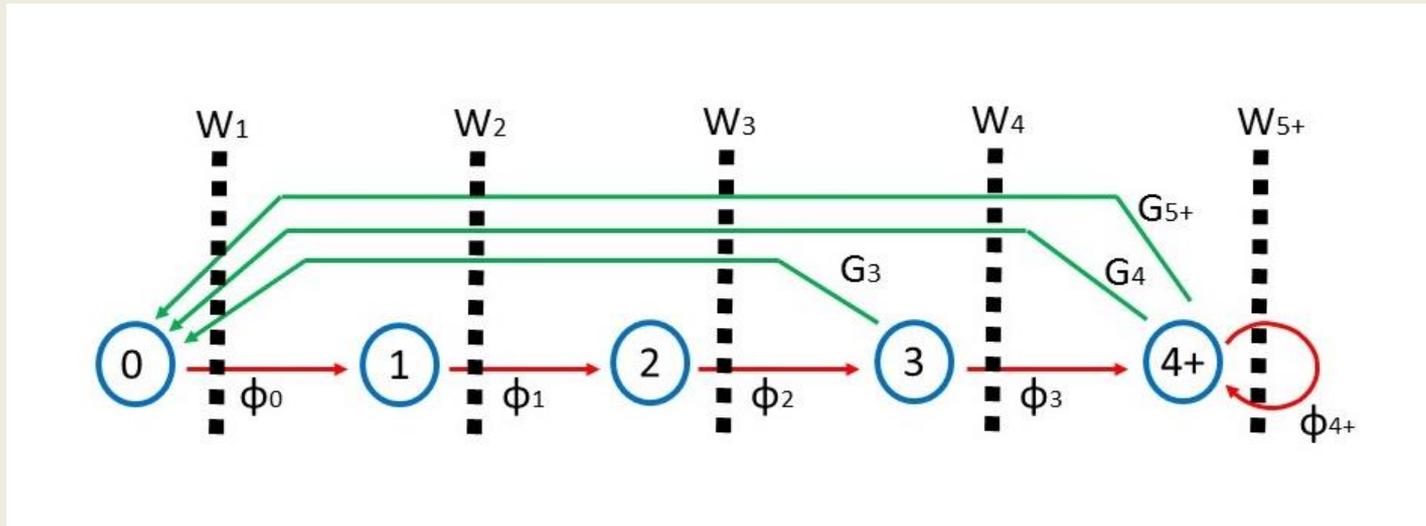
population persistence requires

- High annual survival during immature life-stages  
(0,6 – 0,7 and  $\approx$  adult survival)





# Demography & population model



- Combine survival probabilities and birth rates → population projection matrix (“Leslie matrix”)
- Population growth rate:  $r = 0,06$





## Population growth rate ( $r$ )

Sensitivity of  $r$  to changes in survival and birth rates

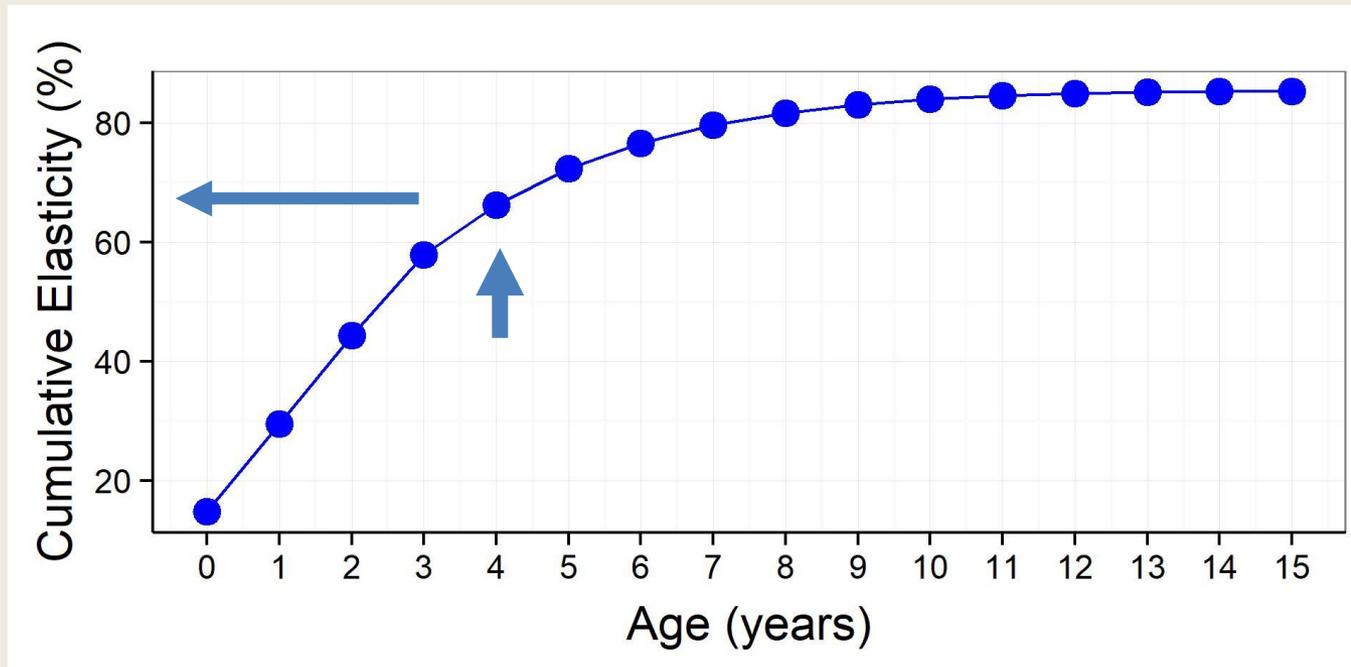
- 15% of  $\text{Var}(r) \sim$  changes in birth rates
- **85%** of  $\text{Var}(r) \sim$  changes in survival rates
- Changes in **survival** rates most influential on  $r$





# Population growth rate ( $r$ )

## Sensitivity of $r$ to age-specific survival rates



Changes in survival rates of *immature adders* have largest impact (60 – 70%) on population growth rate (confirmed by stochastic population models)





## Demography and conservation

- Species conservation aims at increasing population numbers, i.e.,  $r > 0$
- Conservation actions should focus on processes with largest impact on population growth rate
  - ⇒ Survival rates of immature adders
- Young adders reside mostly in feeding areas
  - ⇒ Conservation of suitable feeding habitats





## Implications for conservation

- Today's efforts (monitoring, management) focus on winter habitats, especially dens and basking spots of adult (male) adders
- [where adders are most easily observed]
- Demographic analyses stress importance of survival of the often “invisible” **immature** snakes
- [the most visible life stages are not necessarily the most influential and critical!]





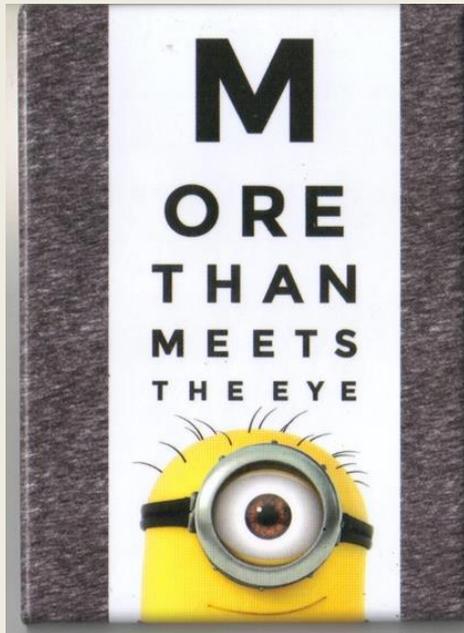
## Implications for conservation (2)

- Decline of adder populations **may** be caused by unseen alterations at the feeding (“summer”) habitats
- Safeguarding of **both winter and feeding** habitats, and of migration routes, is critical for adder conservation
- More knowledge on **immature** life stages and of the **feeding habitats** is badly needed!





And the moral of the story ...  
“There’s more to the picture  
than meets the eye”



Thanks!!

