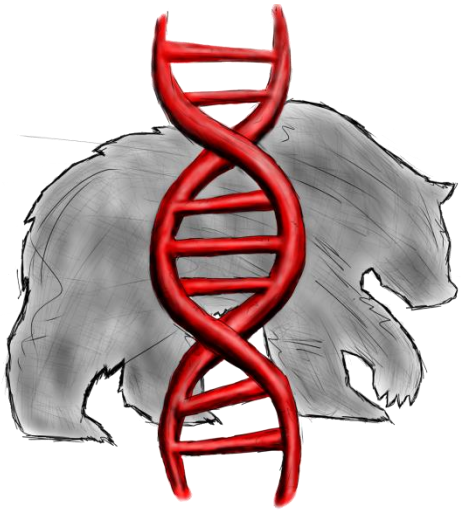
Monitoring of effective population size in a hunted population of brown bears (Ursus arctos) shows effects of different management approaches in neighboring countries



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LIFE DINALP BEAR LIFE13 NAT/SI/000550

Effective population size (*Ne*)

Possibly one of the most important parameters

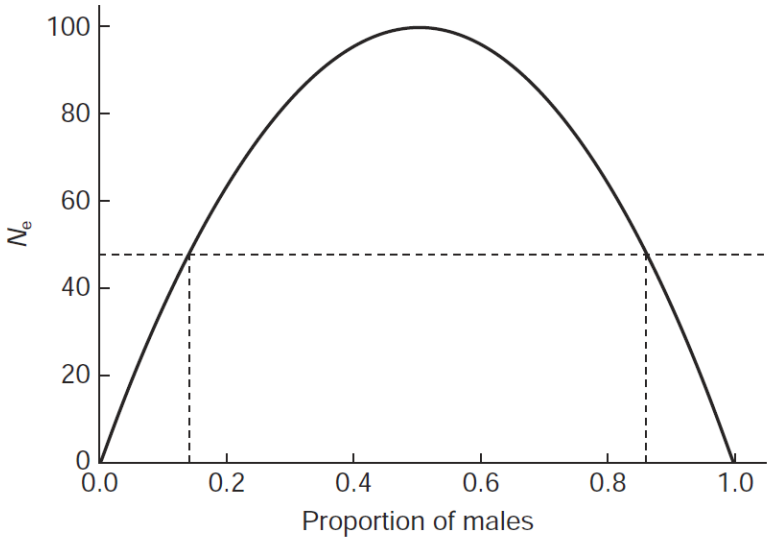
for evolutionary and conservation biology.

Index describing the rate of random genetic change - direct indicator of both **evolutionary potential** and **sensitivity to genetic stochasticity**.

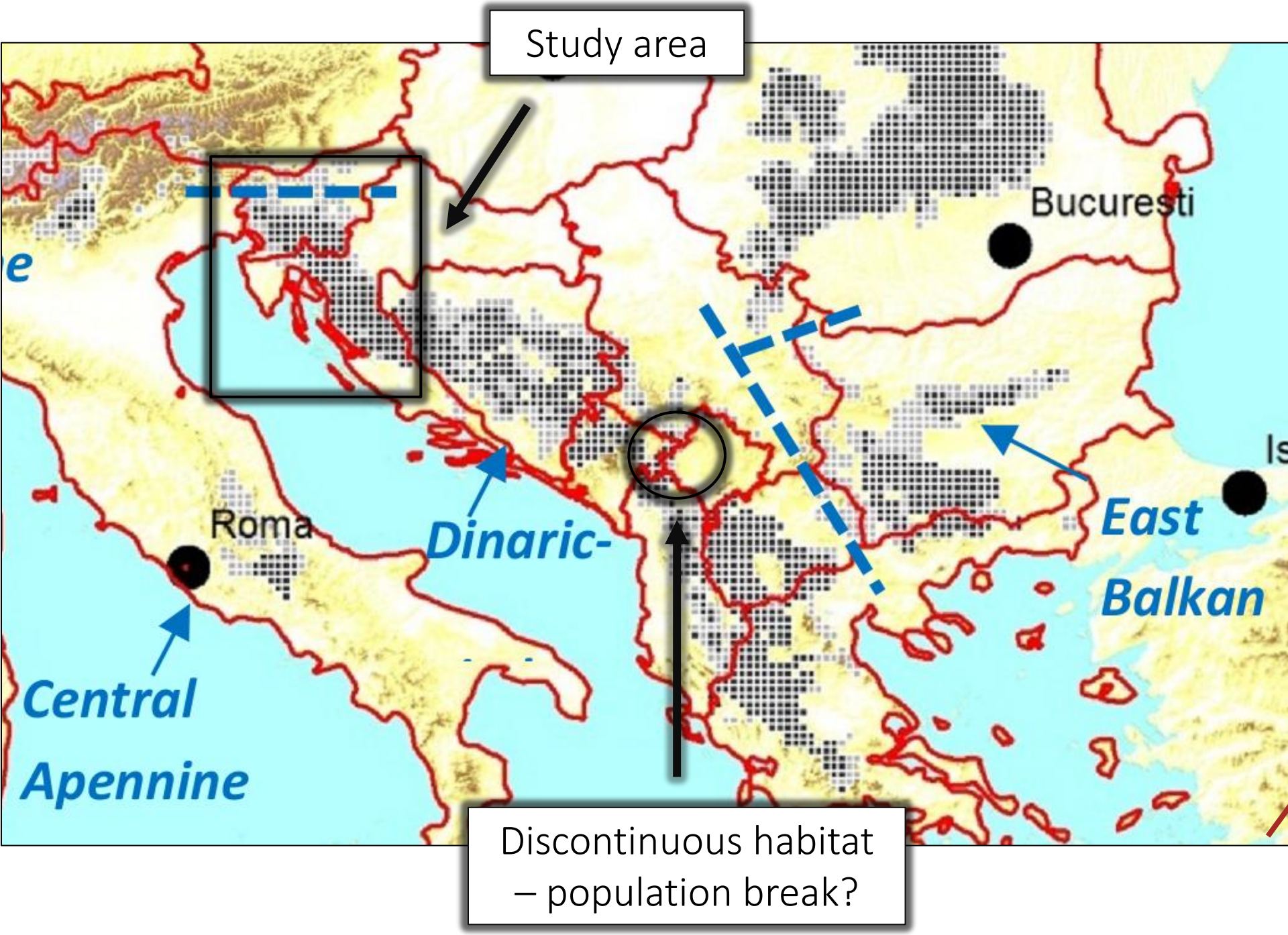
Directly effects the **viability of a population**.

Population stratification -> *Ne*

Effect of unequal sex ratio on Ne



- Unequal reproductive success
- Age structure (generation overlap)
- Unequal sex ratio
- Spatial structure
- Age of first reproduction
- ….


Study area
Bucuresti
Roma
Dinaric-
East
Balkan
Central
Apennine
Discontinuous habitat
– population break?

NW Dinaric Mts.

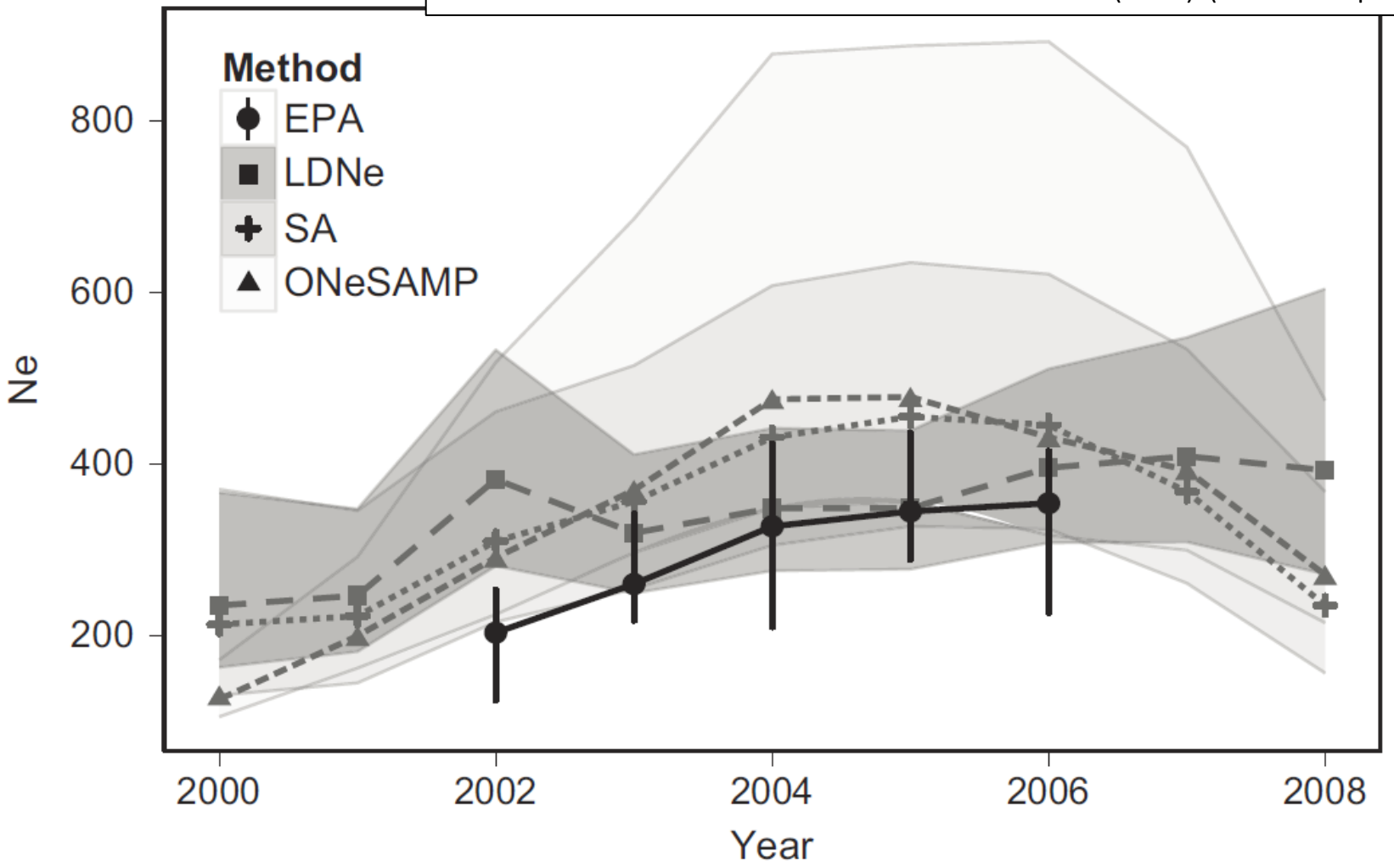
Bears have **different protection status.** All are **hunted.**

Slovenia:
Protected, cull to regulate population size.
~500 bears.
Young animals killed.

Bosnia:
Game species.
Poor data. ~ 550 bears(?)

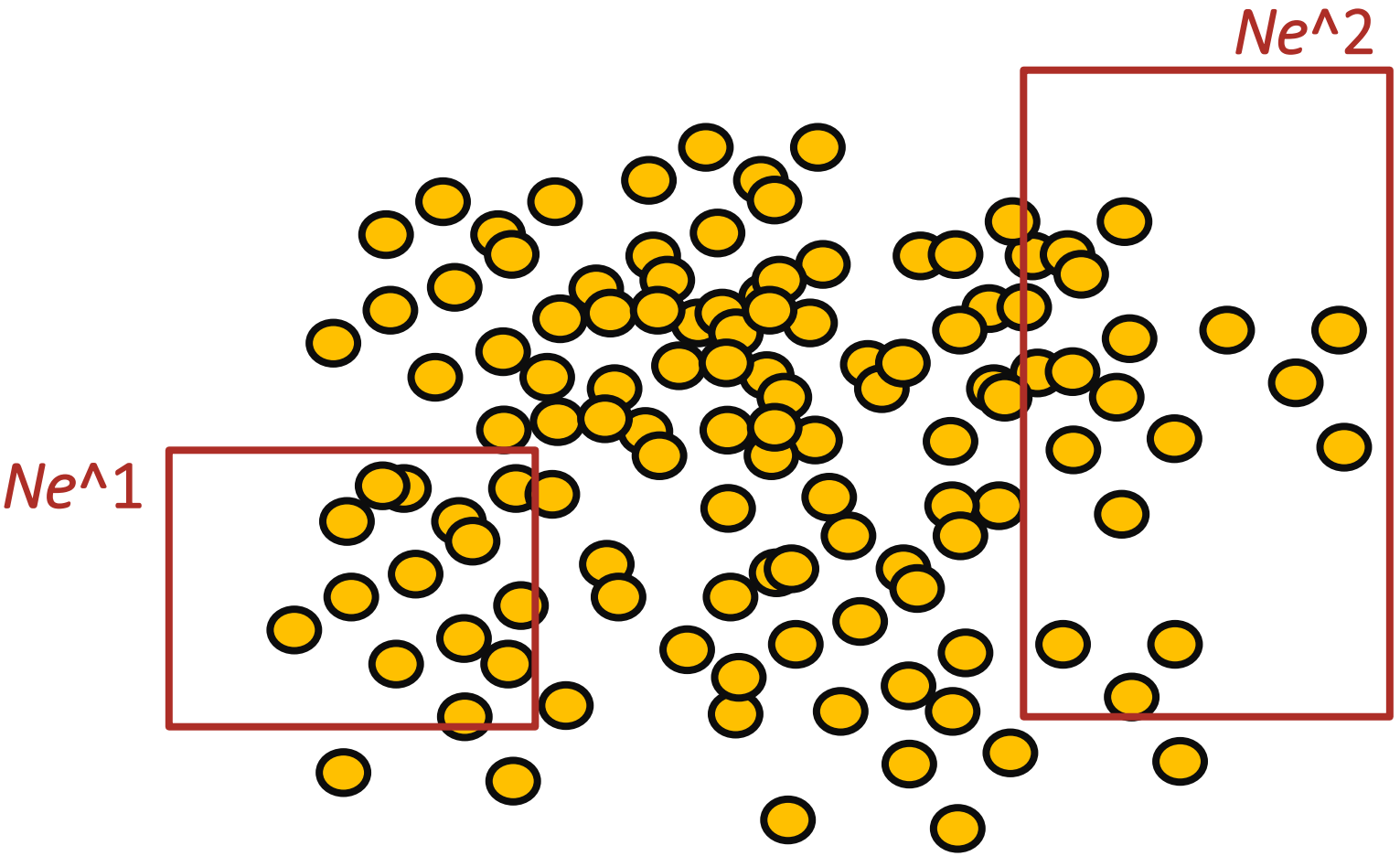
Croatia:
Protected, culled.
~ 1000 bears.
Big (trophy) males killed.

Ne of Dinaric bears estimated ~ 183-350 (276) (SLO samples)



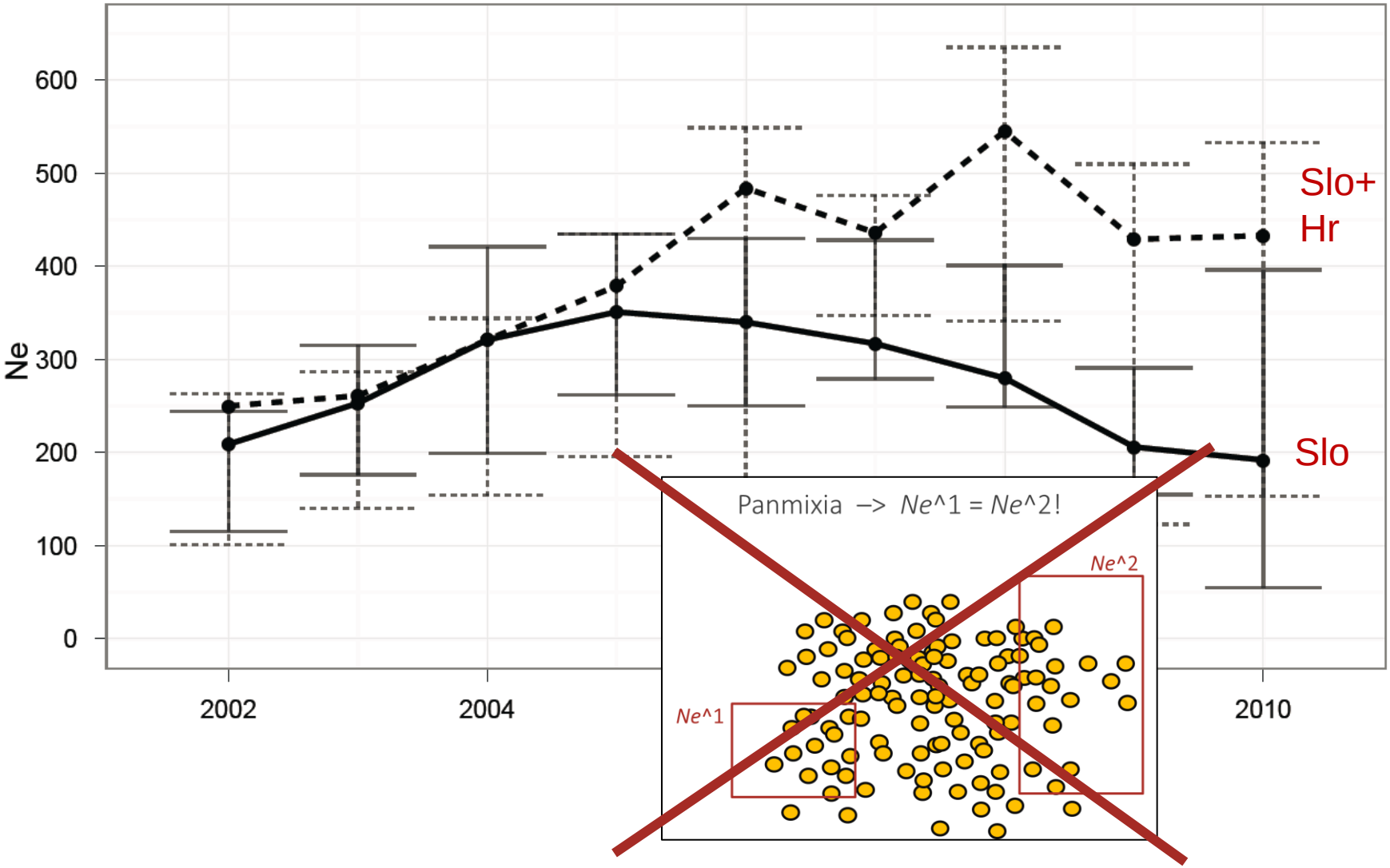
*Skrbinšek et al. (2012) „**Monitoring the effective population size of a brown bear (Ursus arctos) population using new single-sample approaches**“.Molecular Ecology 21:862-875*

Panmixia –> *Ne*^1 = *Ne*^2!



Adding Croatia in the mix

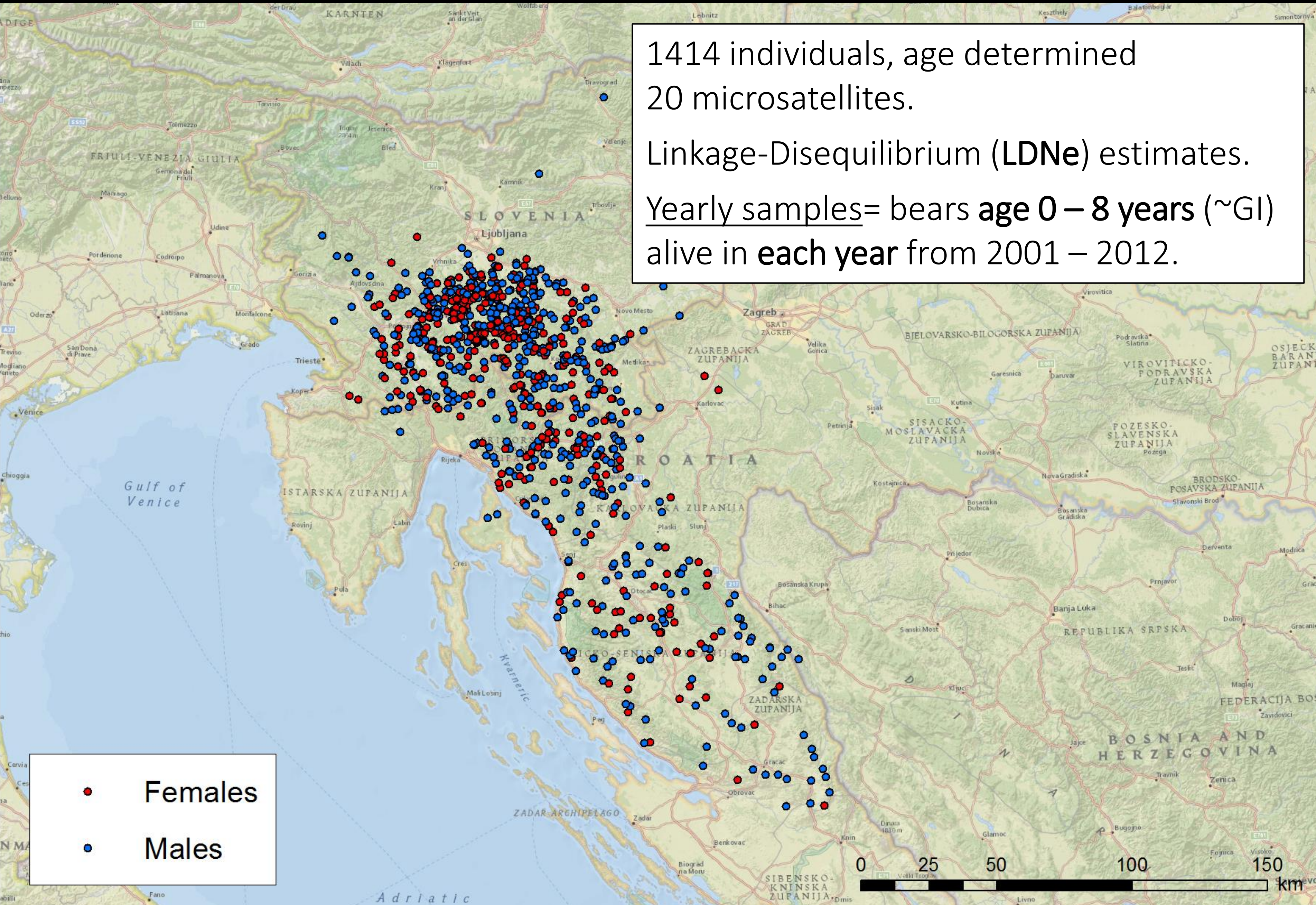
As time moves on…

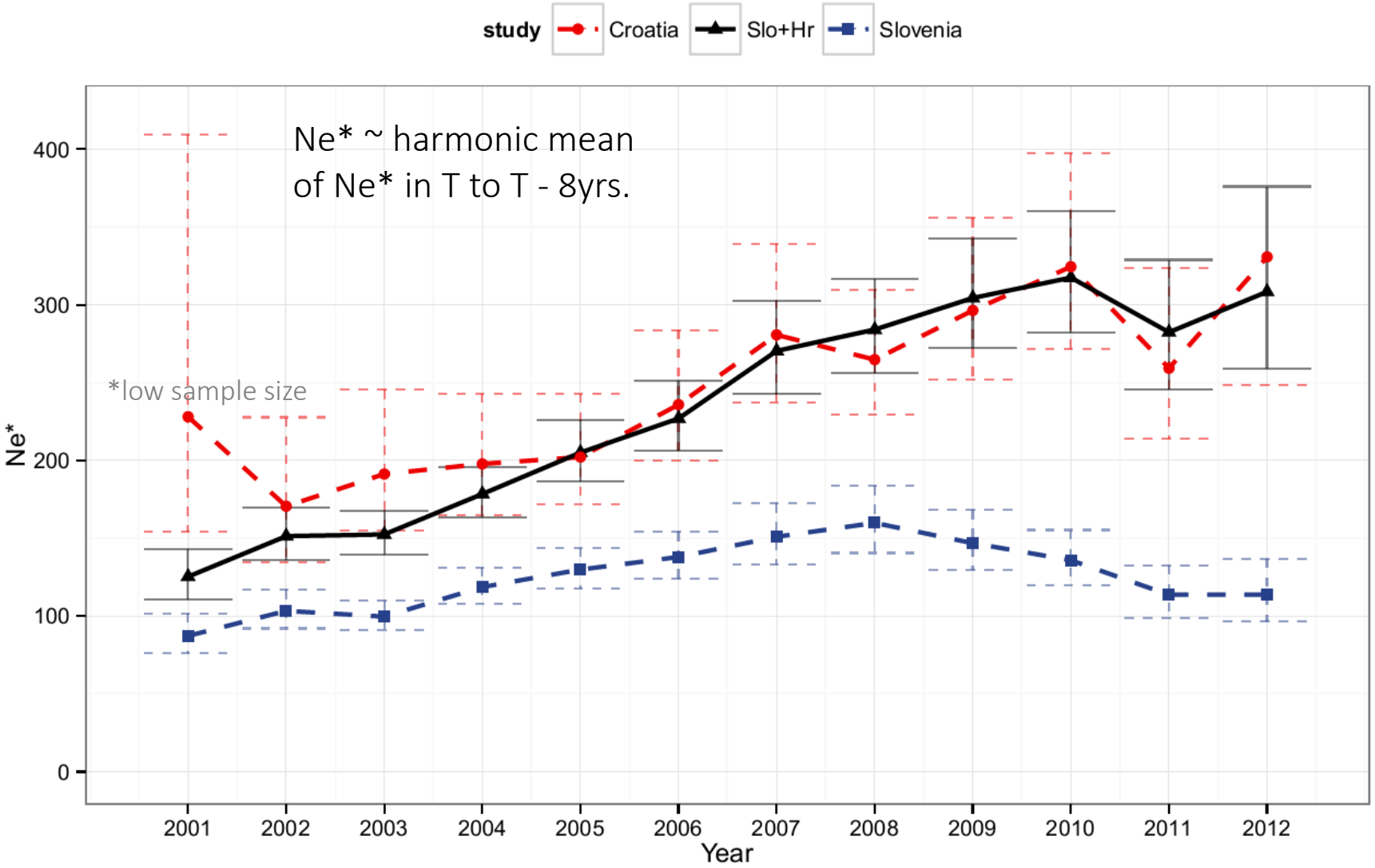


1414 individuals, age determined
20 microsatellites.

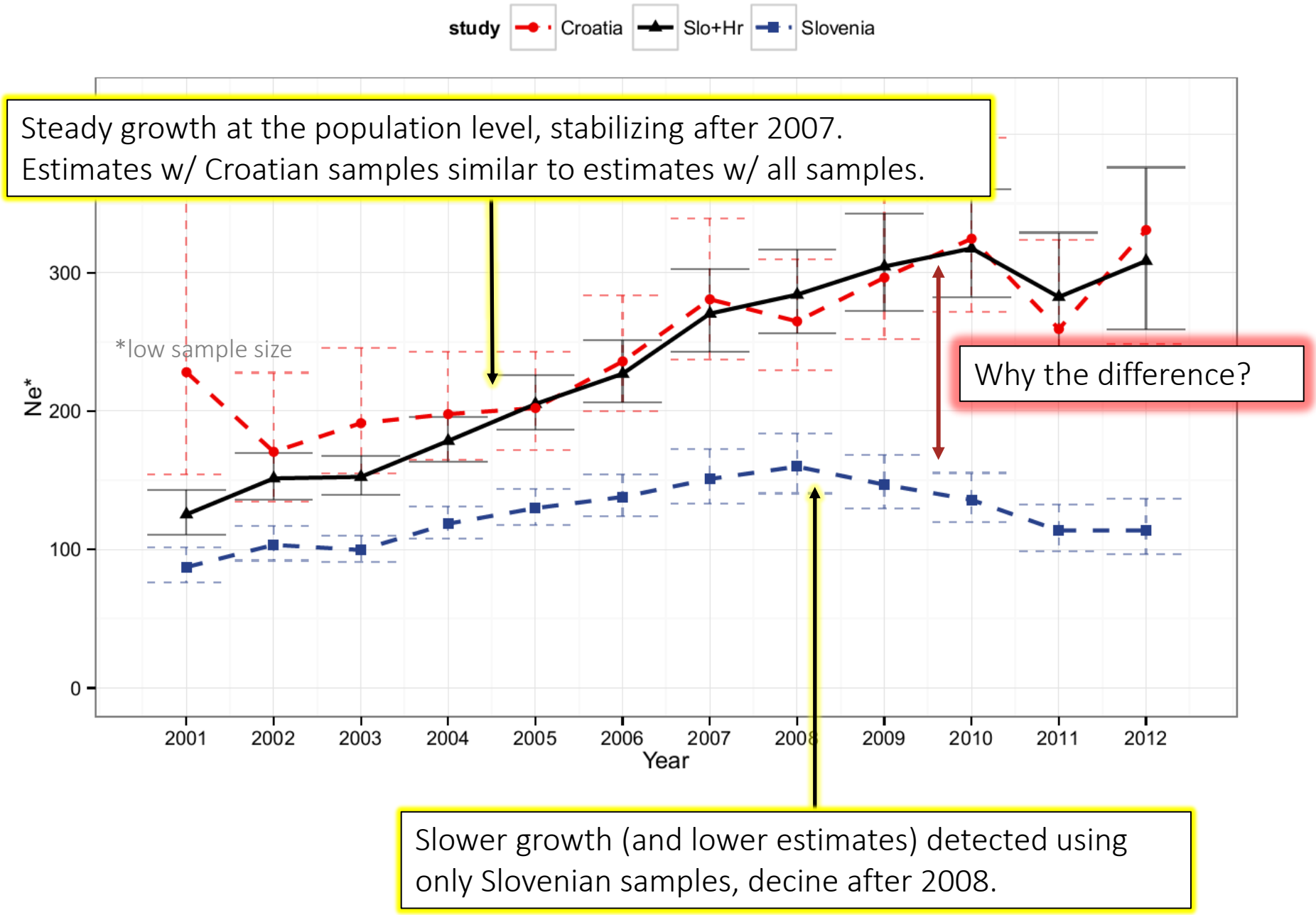
Linkage-Disequilibrium (**LDNe**) estimates.

<u>Yearly samples</u>= bears **age 0 – 8 years** (~GI) alive in **each year** from 2001 – 2012.

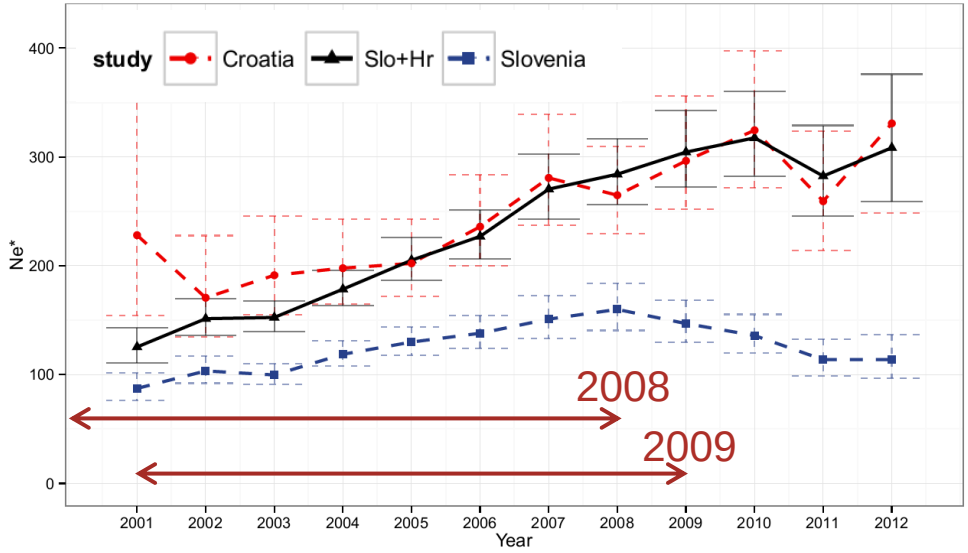




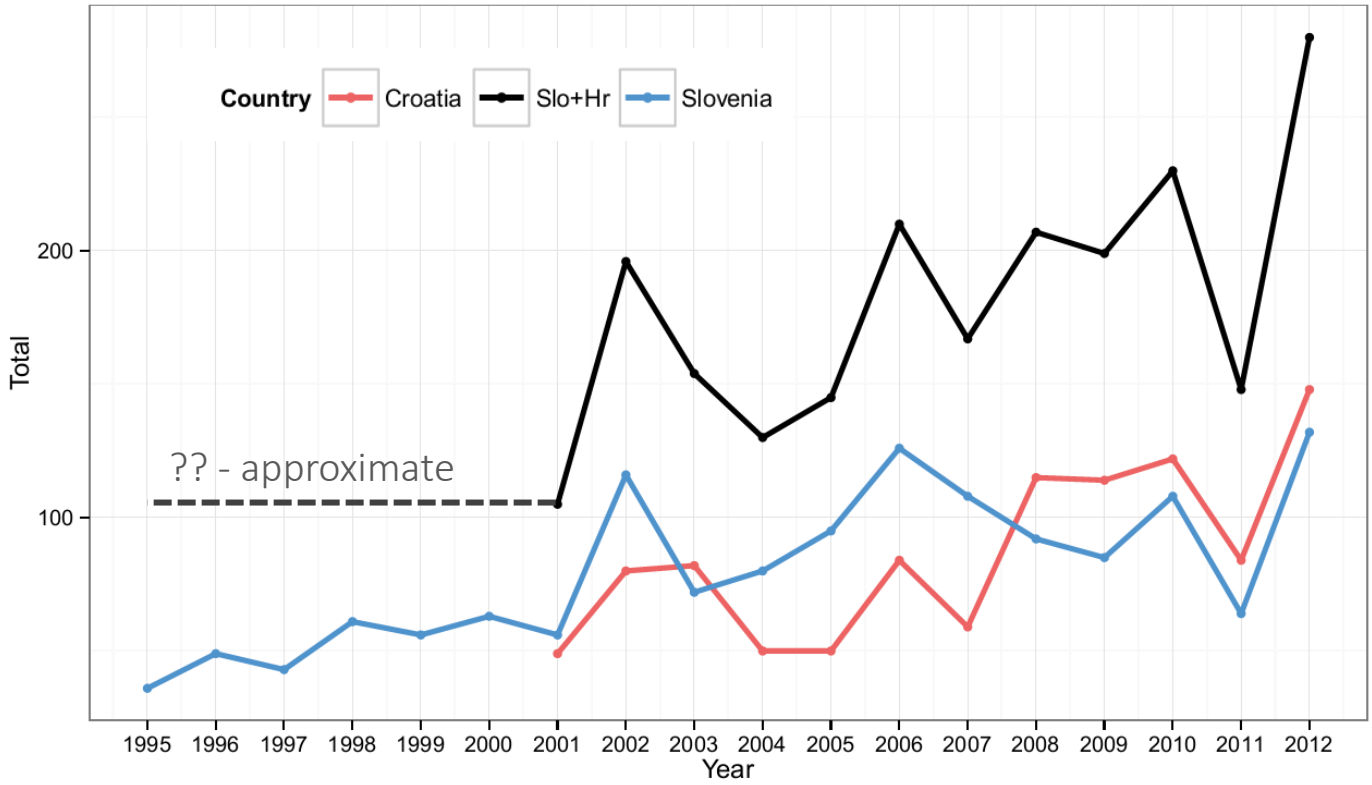
Linkage-Disequilibrium (**LDNe**) estimates. *Ne** - index of effective pop. size
Each sample = bears **age 0 – 8 years** (~generation interval) alive in a **single year**.


study
Croatia
Slo+Hr
Slovenia
Steady growth at the population level, stabilizing after 2007.
Estimates w/ Croatian samples similar to estimates w/ all samples.
*low sample size
Why the difference?
Slower growth (and lower estimates) detected using only Slovenian samples, decine after 2008.
Ne*
0
100
200
300
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
Year

Effective Pop. Size (Index)

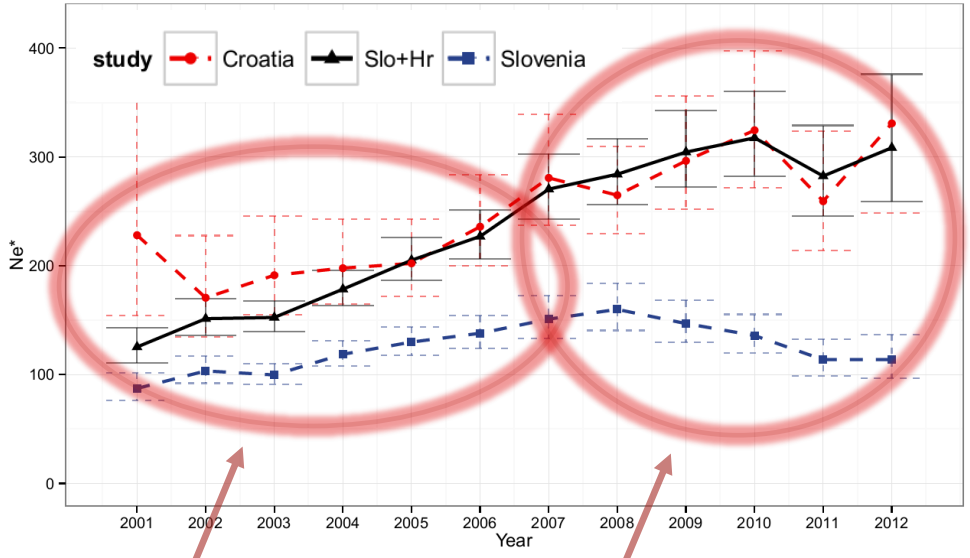


Time lag + smoothing
Ne* ~ harmonic mean of Ne* in T to T - 8yrs.

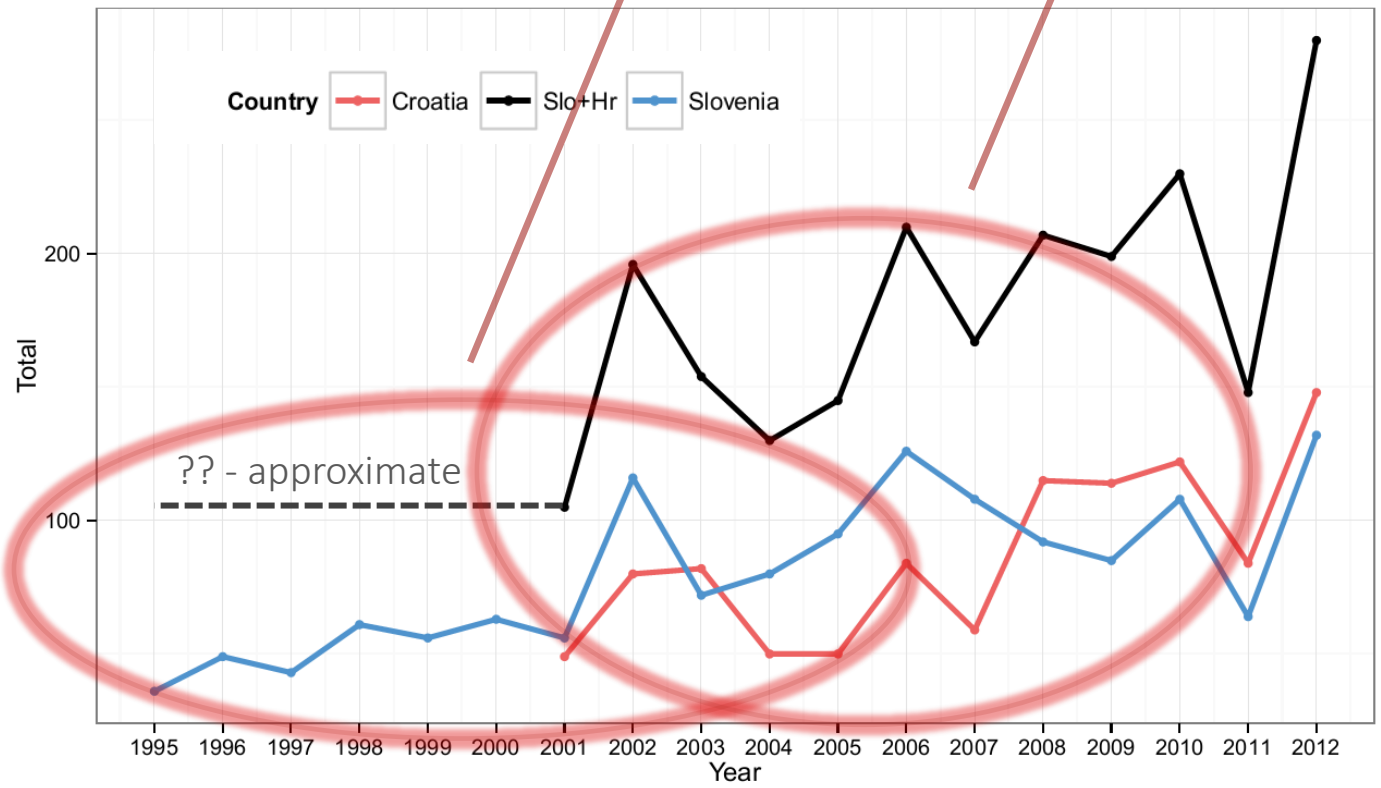


Detected bear mortality

Effective Pop. Size (Index)

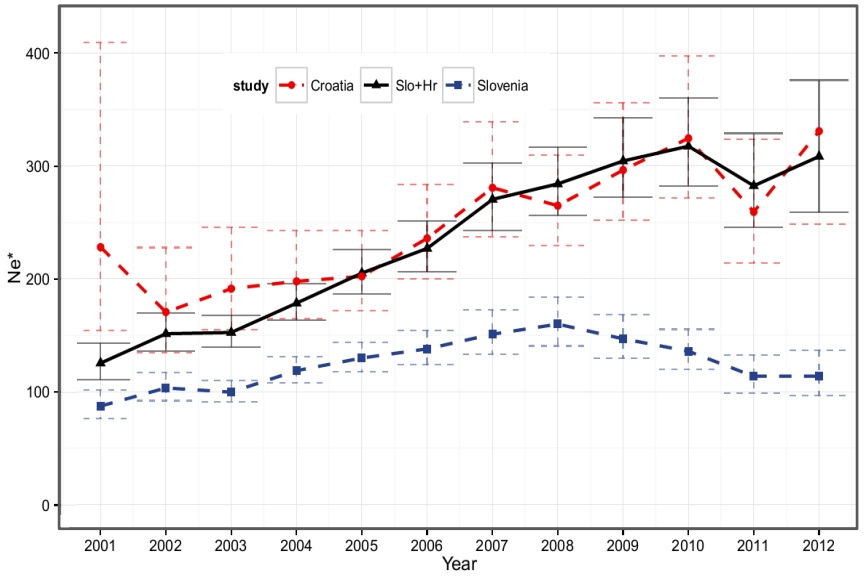


Time lag + smoothing
Ne* ~ harmonic mean of Ne* in T to T - 8yrs.

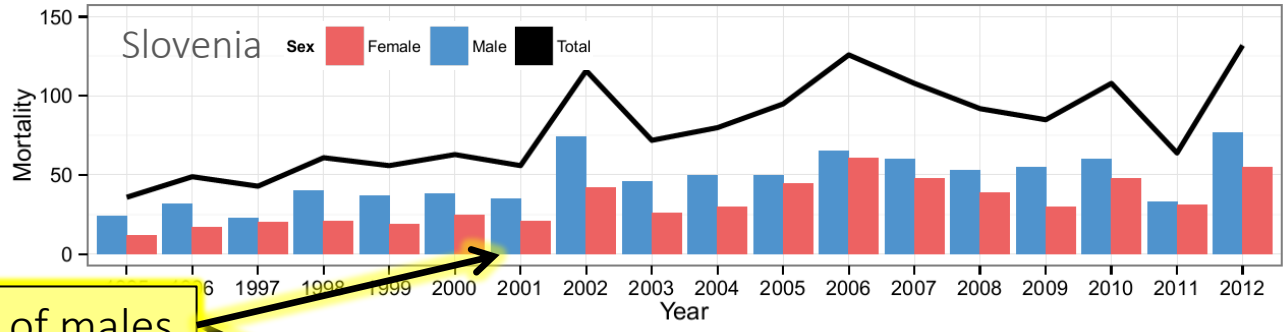


Detected bear mortality

Effective Pop. Size (Index)

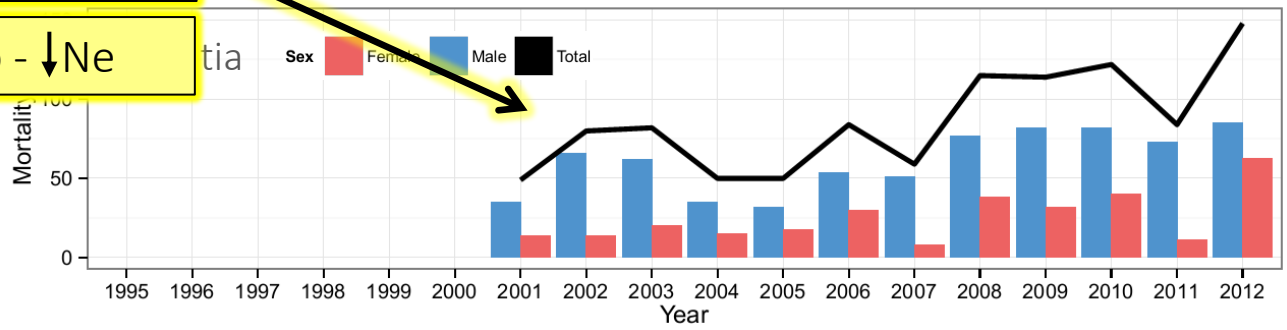


Sex-specific Mortality

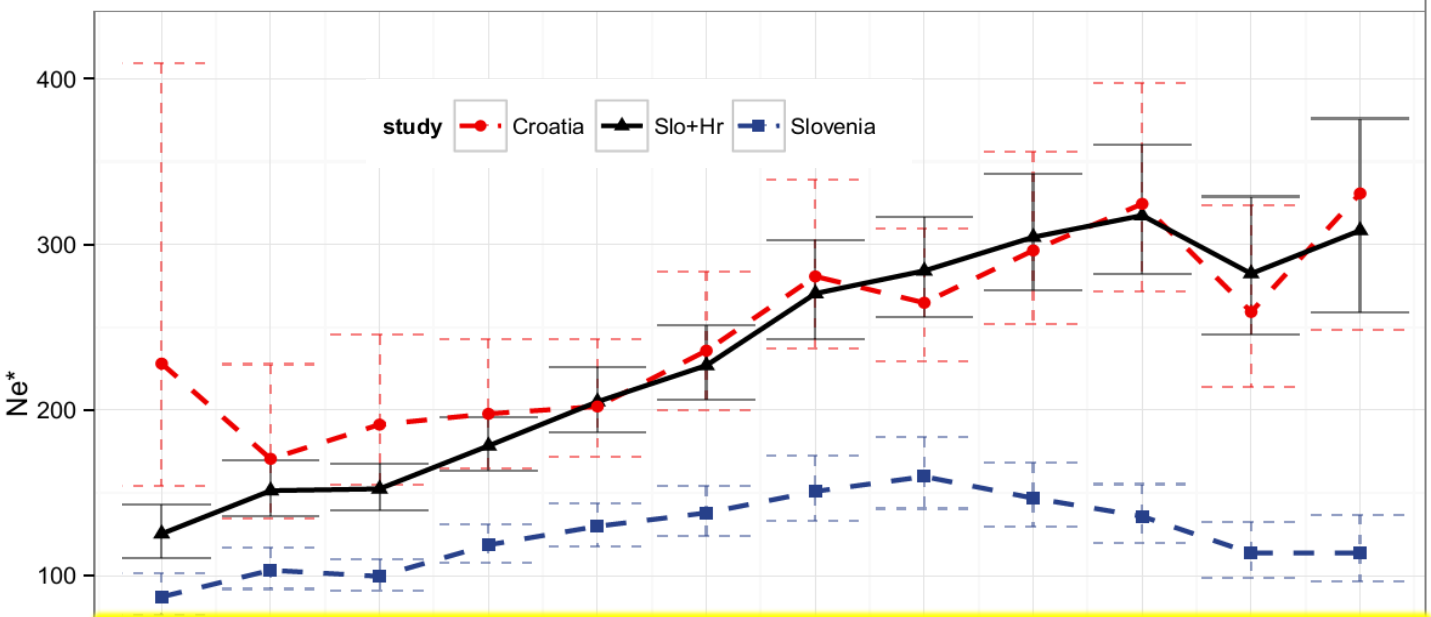


Higher mortality of males

Skewed sex ratio - ↓Ne

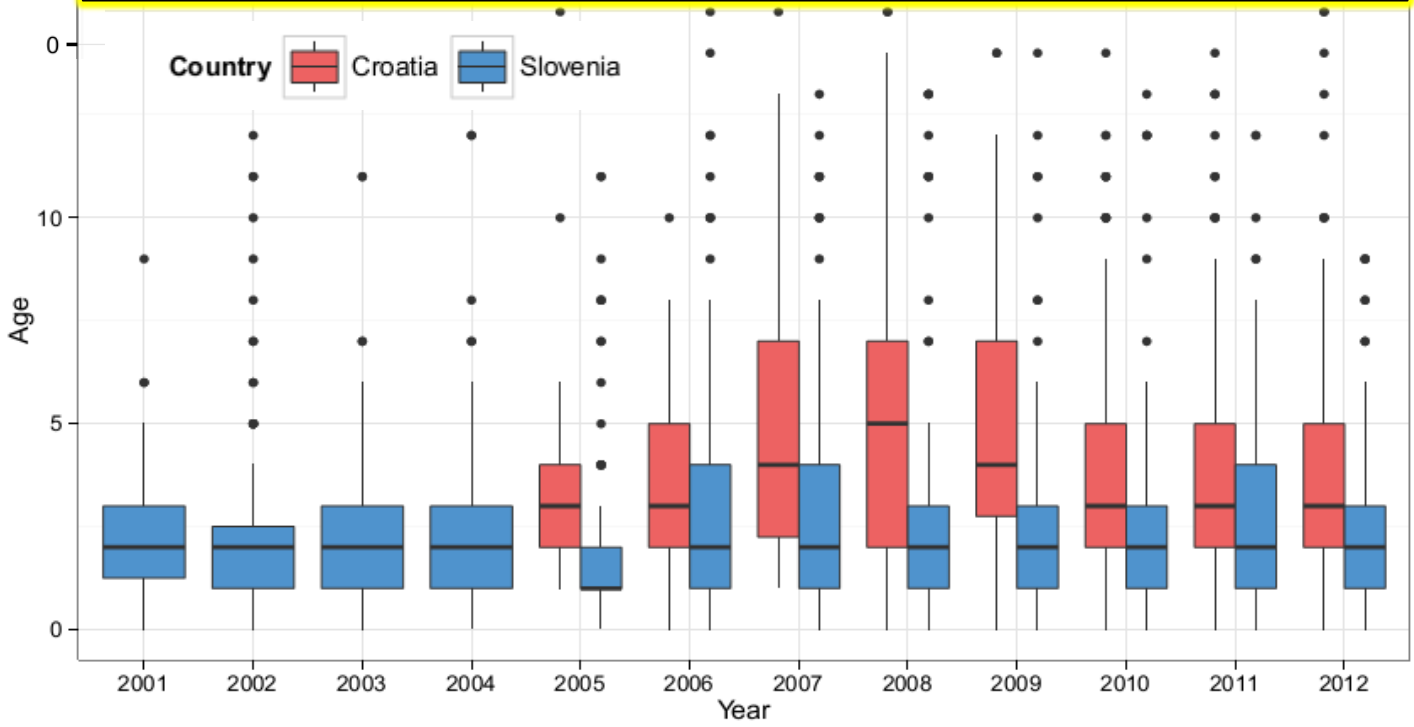


Effective Pop. Size (Index)



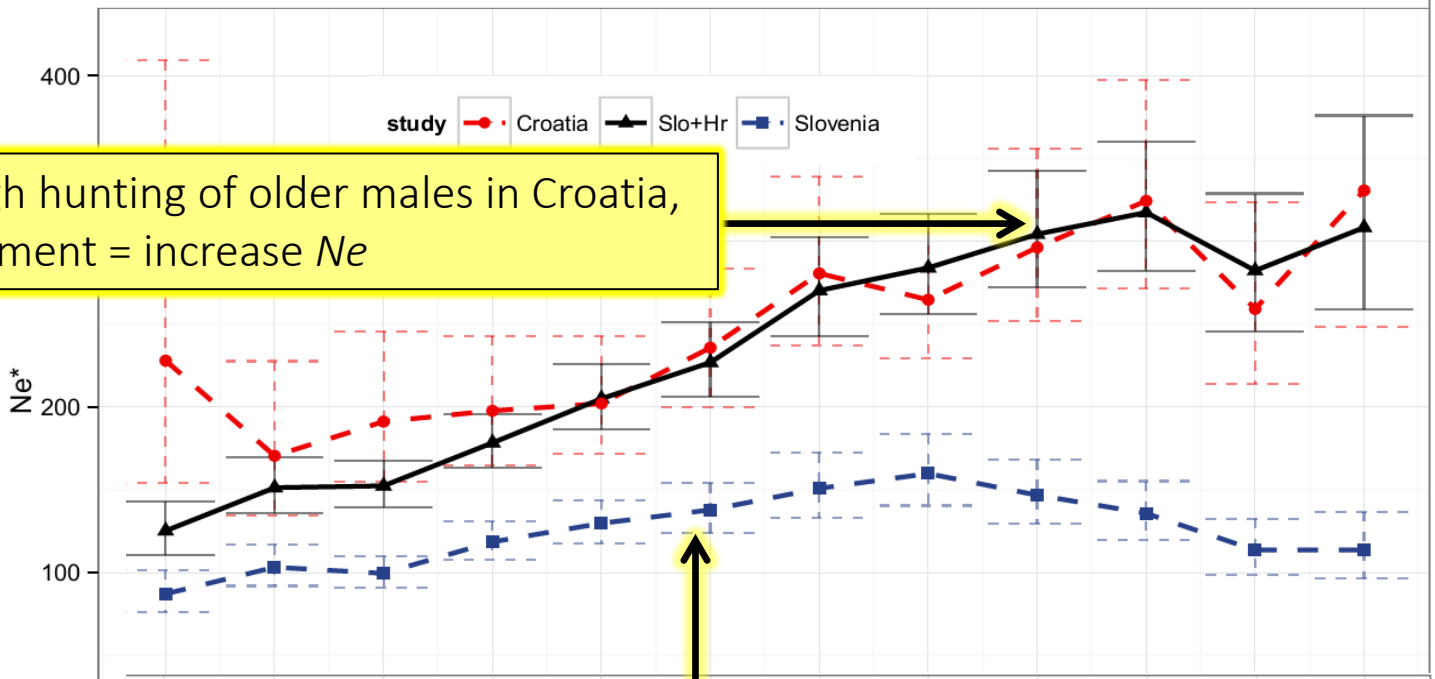
Considerably higher age of killed bears in Croatia, mostly males.

Age Structure Culled Bears



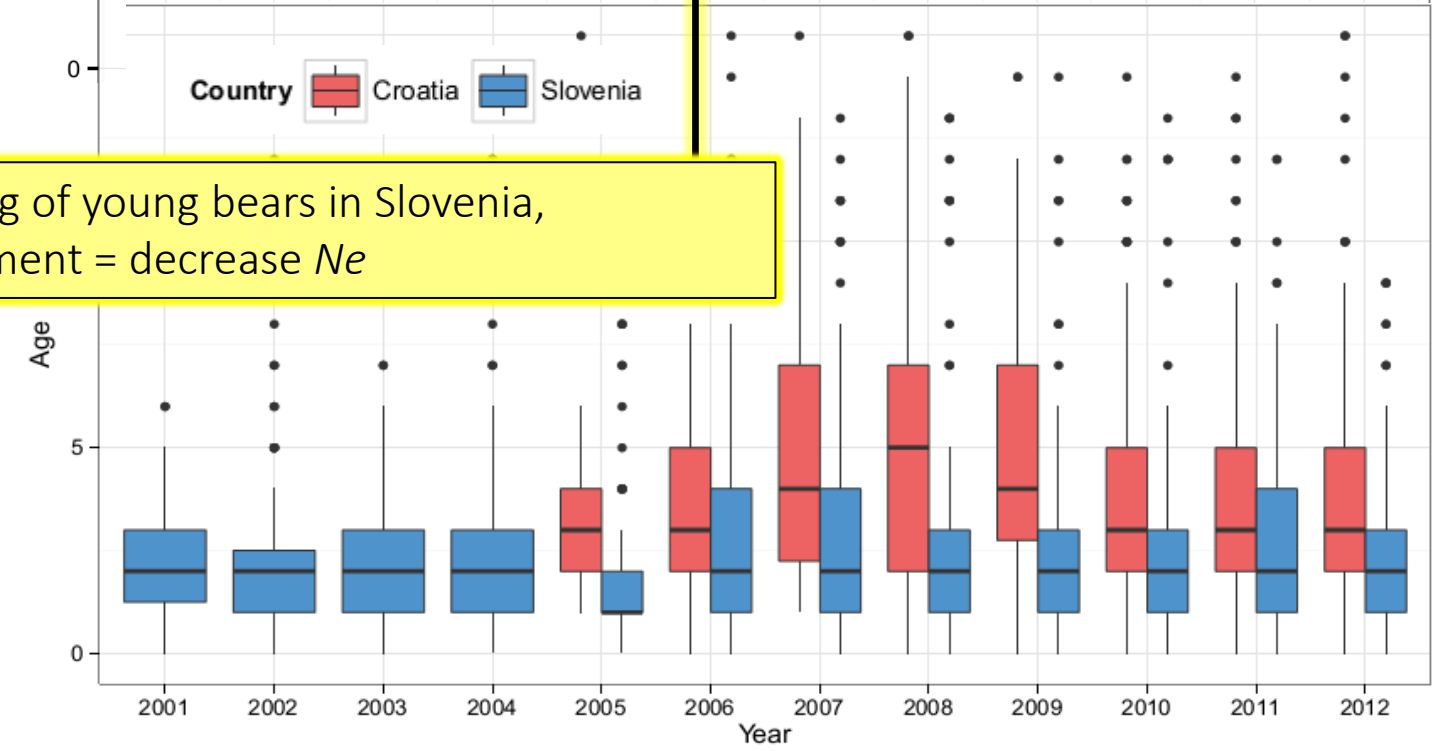
Effective Pop. Size (Index)

Includes high hunting of older males in Croatia, high recruitment = increase *Ne*



Age Structure Culled Bears

High hunting of young bears in Slovenia, low recruitment = decrease *Ne*

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Management – caused drivers of *Ne* dynamics in NW Dinaric Mts.

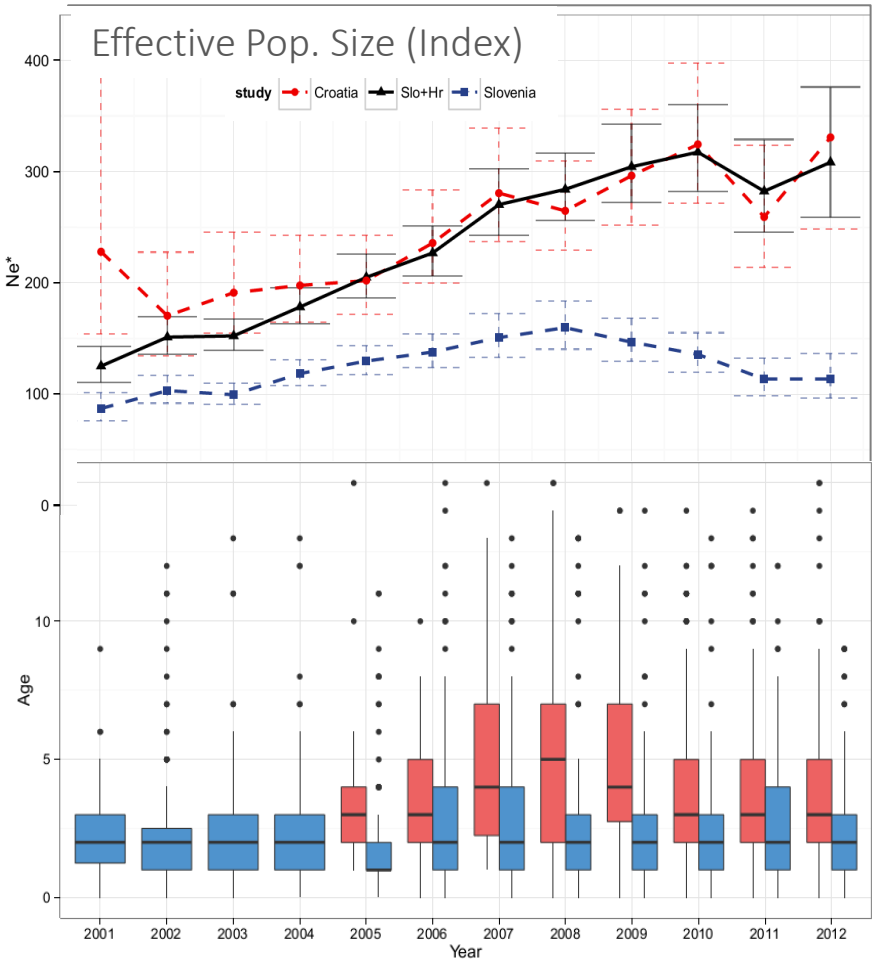
Slovenia:

- ↑ mortality young
- ↑ mean age reproductive males
- ↓ recruitment
- ↑ variance in lifetime reprod. success
- ↑ relatedness
- ↓ *Ne* (detectable in local estimates)

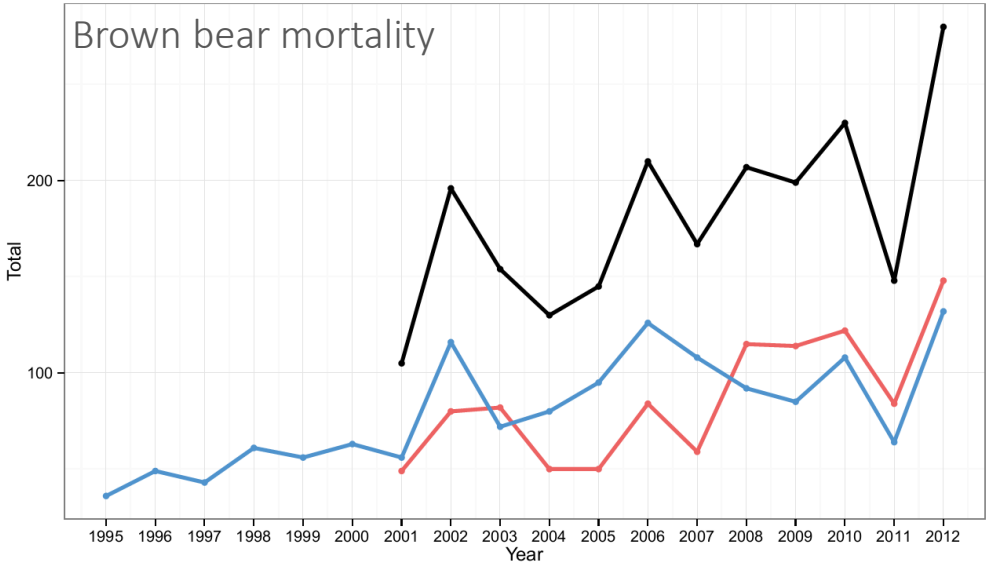
Croatia (Bosnia?):

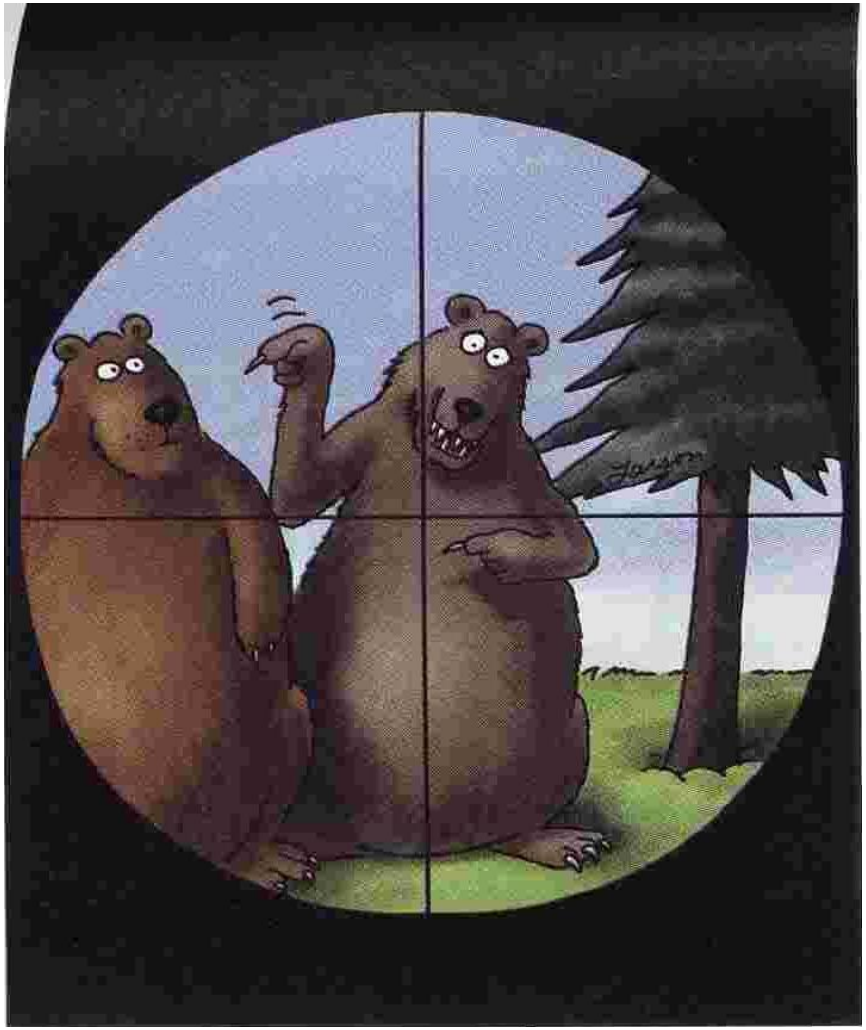
- ↑ mortality adult males
- ↓ mean age reproductive males
- ↑ recruitment
- ↓ variance in lifetime reprod. success
- ↓ relatedness
- ↑ *Ne*

Growing population…
Different management – different outcomes!



Age structure of Mortality
Slovenia vs. Croatia





So… which bears should we shoot?

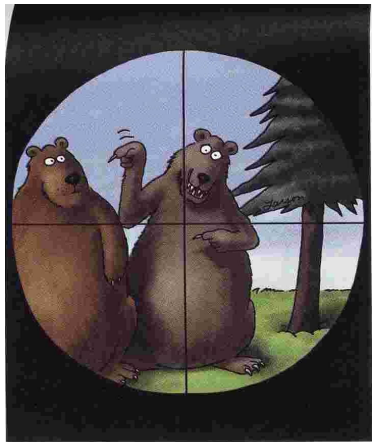
Shooting young bears

Pro:

- Remove „troublemakers“
- Preserve „reproductive core“

Con:

- Decreasing *Ne*
- Low value of bears for hunters



VS

Shooting old bears

Pro:

- Increasing *Ne*
- Better hunter acceptance
- Removal of scarry old bears – less conflict bears??

Con:

- Infanticide!
- Removal of the least conflict animals (?)
- Evolution?!

Systematic monitoring of effective population size?

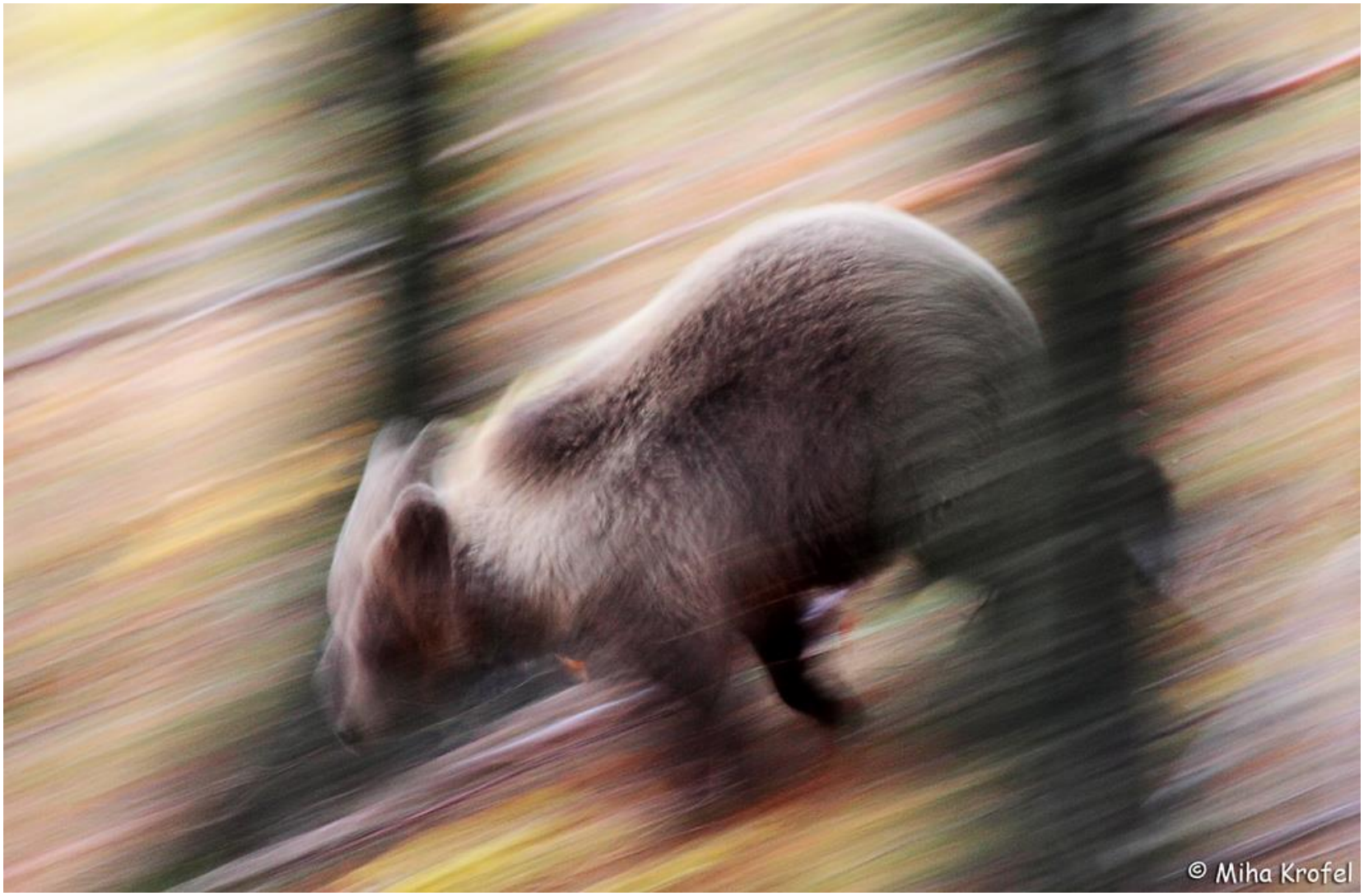


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Photo: Miha Krofel