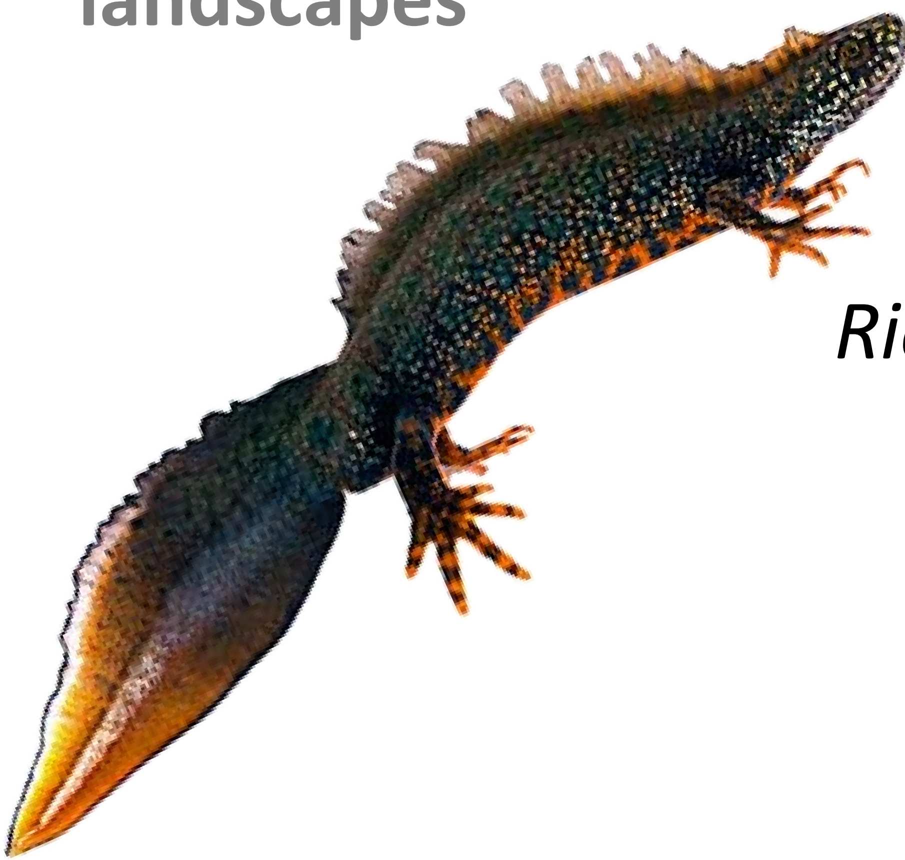
How many newts in how many populations? Modelling the viability of newt metapopulations in fragmented landscapes



Richard A. Griffiths

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How will species and populations fare in the future?

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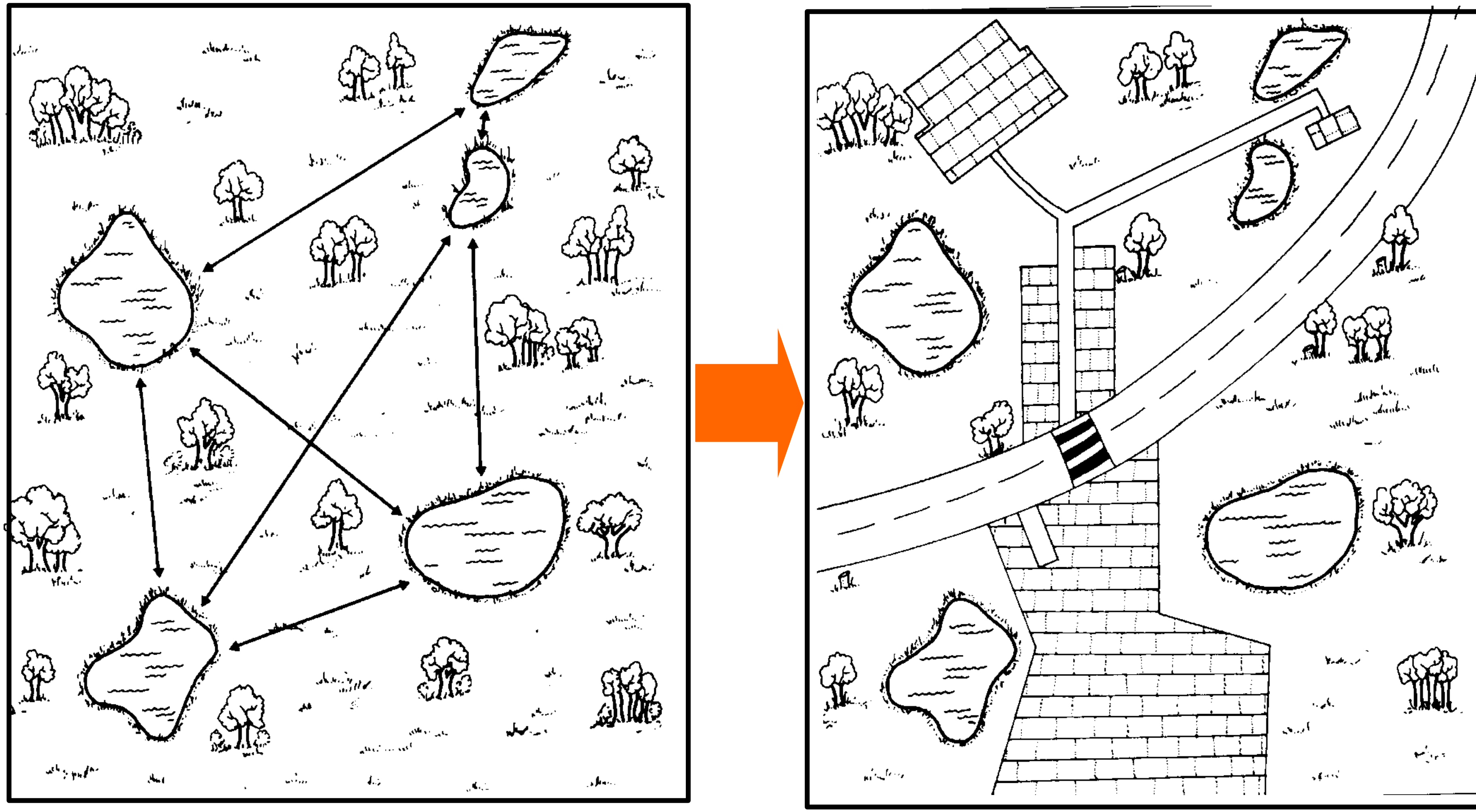
Retaining ponds within a fragmented landscape

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How many ponds and how many newts in the designed landscape?

Distribution of Great Crested Newt in Kent (Nov 2010)

What is population viability analysis (PVA)?

- Analytical models
- Deterministic single-population models
- Stochastic single-population models
- Metapopulation models
- Spatially explicit models

- VORTEX
- RAMAS Series
- GAPPS
- INMAT
- ALEX

Deterministic model

Population size 2009 = 100

+ 10 births
- 7 deaths

Population size 2010 = 103

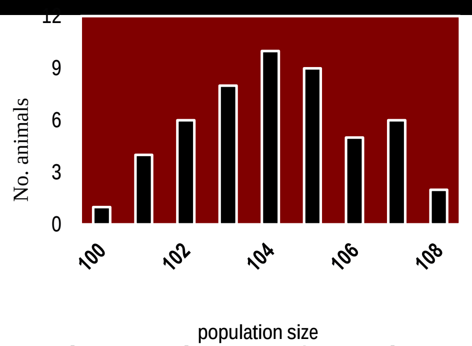
No variations in population size

Stochastic model

Population size 2009 = 100

+ 10 ± 3 births
- 7 ± 2 deaths

Population size 2010 = 103 ± 5



1000 simulations of each scenario

Extinction risk: proportion of populations going extinct

Constructing a PVA

POPULATION PARAMETERS

initial population size

birth rate

death rate

age structure

density dependence

metapopulation structure

ENVIRONMENTAL PARAMETERS

carrying capacity

environmental stochasticity

demographic stochasticity

catastrophes

GENETIC PARAMETERS

relatedness between individuals

genetic stochasticity

OUTPUT PARAMETERS

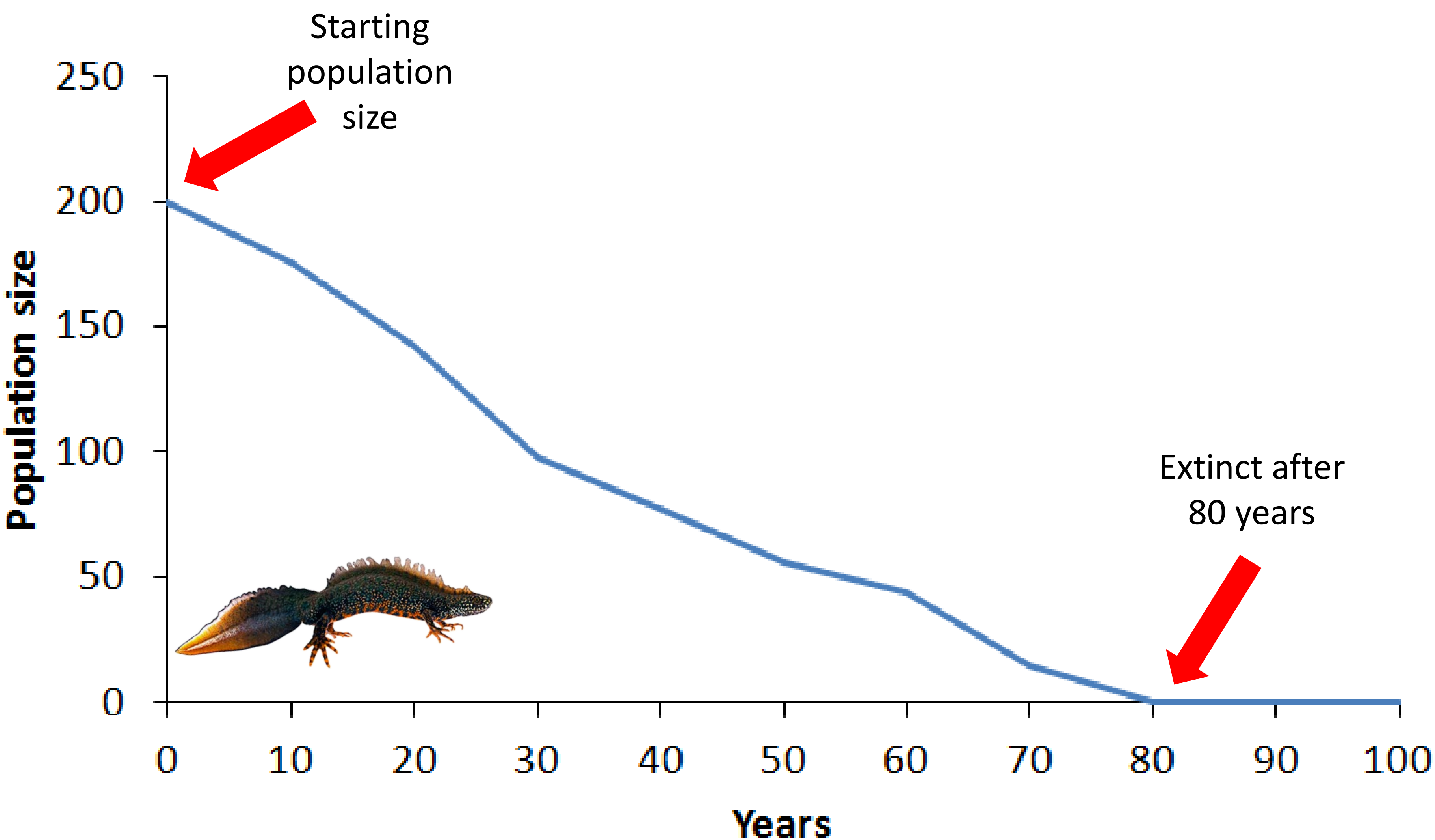
projected population size

probability of extinction

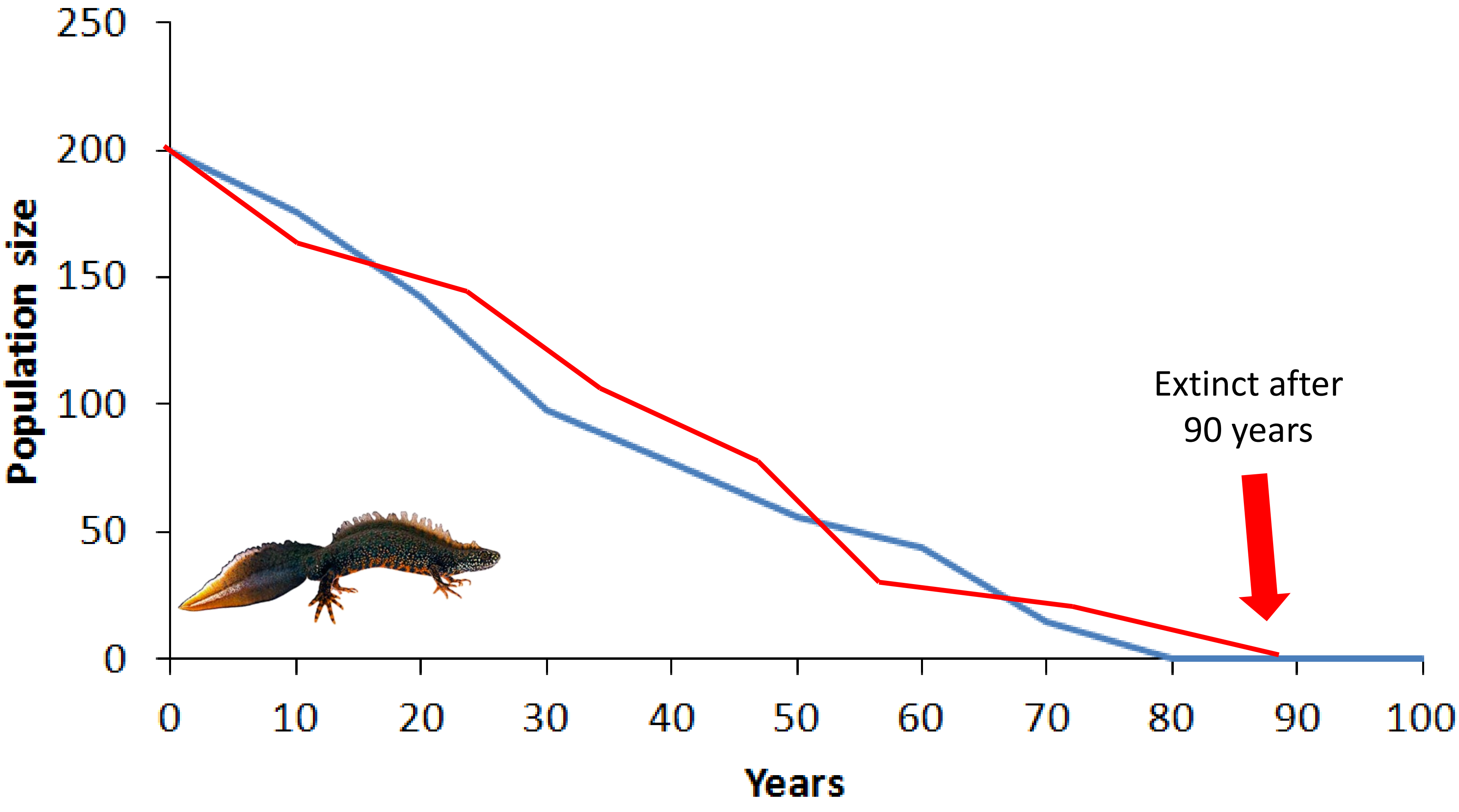
time to extinction

effects of management interventions

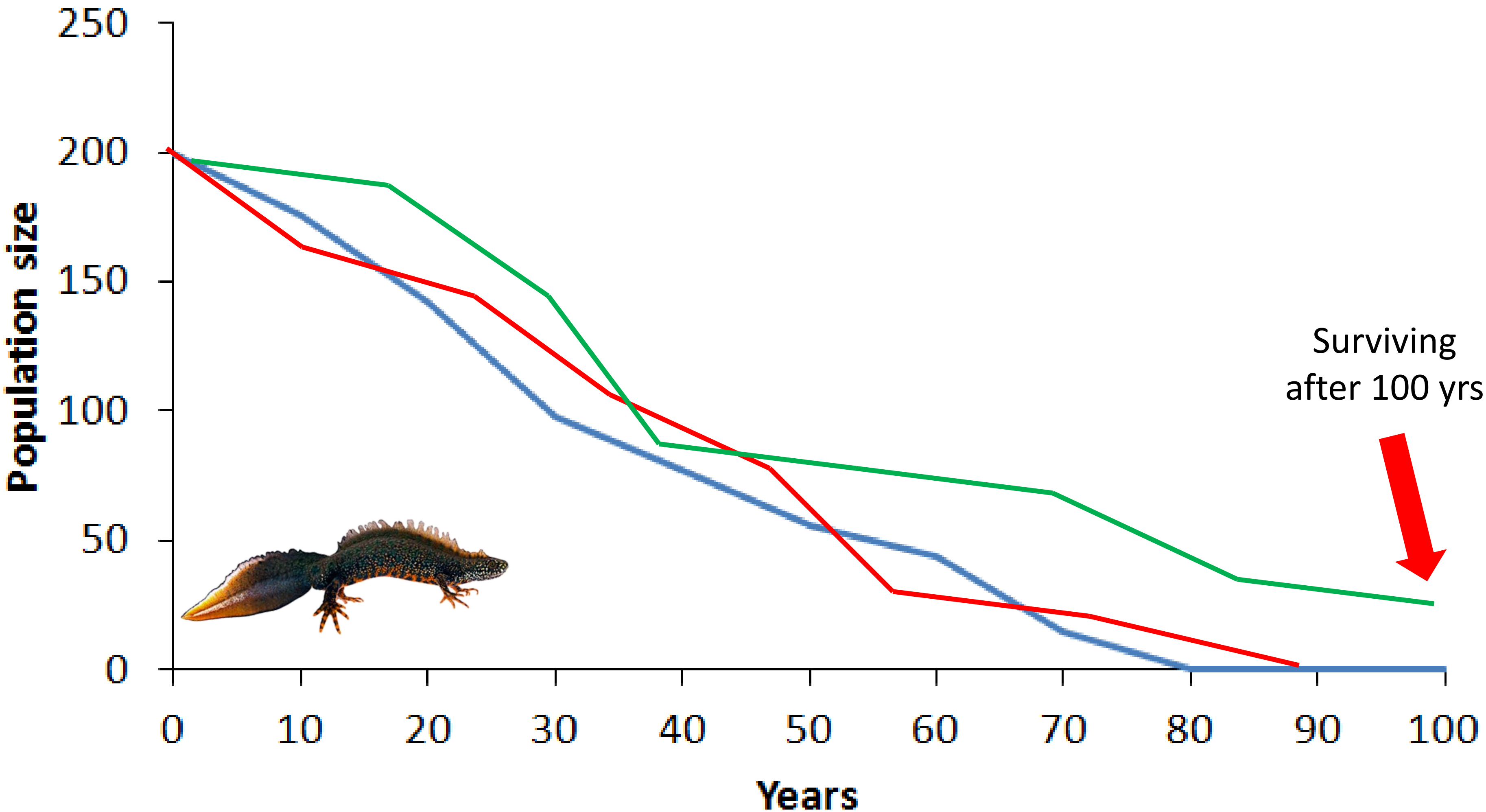
Running a PVA



Running a PVA



Running a PVA



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Sources of data:

- **Arntzen, J. W. & Teunis, S. F. M. (1993).** A six year study on the population dynamics of the crested newt (*Triturus cristatus*) following the colonization of a newly created pond. *Herpetological Journal* **3**, 99-110.

- **Miaud, C., Joly, P. & Castanet, J. (1993).** Variation in age structures in a subdivided population of *Triturus cristatus*. *Canadian Journal of Zoology* **71**, 1874-1879.

- **Oldham, R. S. (1994).** Habitat assessment and population ecology. In: *Conservation and management of great crested newts.* T. Gent & R. Bray (Eds.). English Nature Science Reports no. 20, Peterborough

- **Williams, C. (2000).** Metapopulation dynamics of the crested newt (*Triturus cristatus*). PhD thesis, University of Kent.

- **Kupfer, A. & Kneitz, S. (2000).** Population ecology of the geat crestd newt (*Triturus cristatus*) in an agricultural landscape: dynamics, pond fidelity and dispersal. *Herpetological Journal* **10**, 165-171.

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Input parameters:

- Adult survival:

  0.68±0.3
- Juvenile survival:

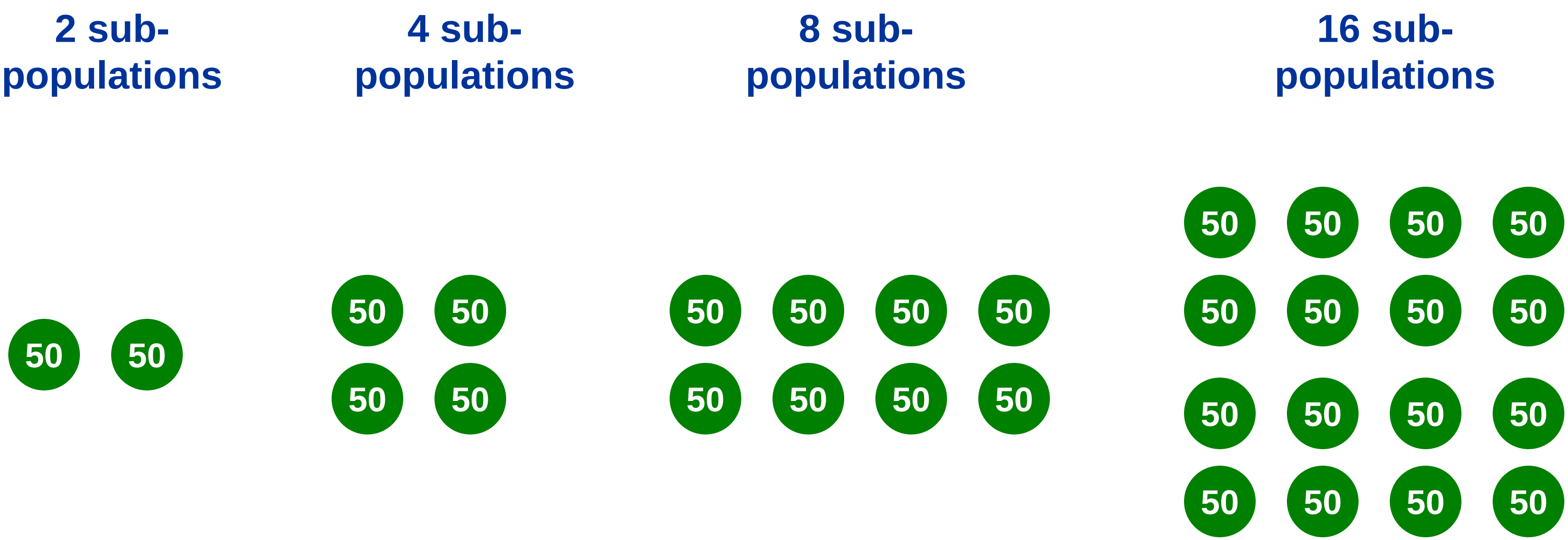
  0.20 ±0.3
- Fecundity:

  189-200
- Demographic stochasticity:

  yes
- Environmental stochasticity:

  yes

Synthetic 'landscapes' of isolated ponds with the same subpopulation sizes, *n*=50



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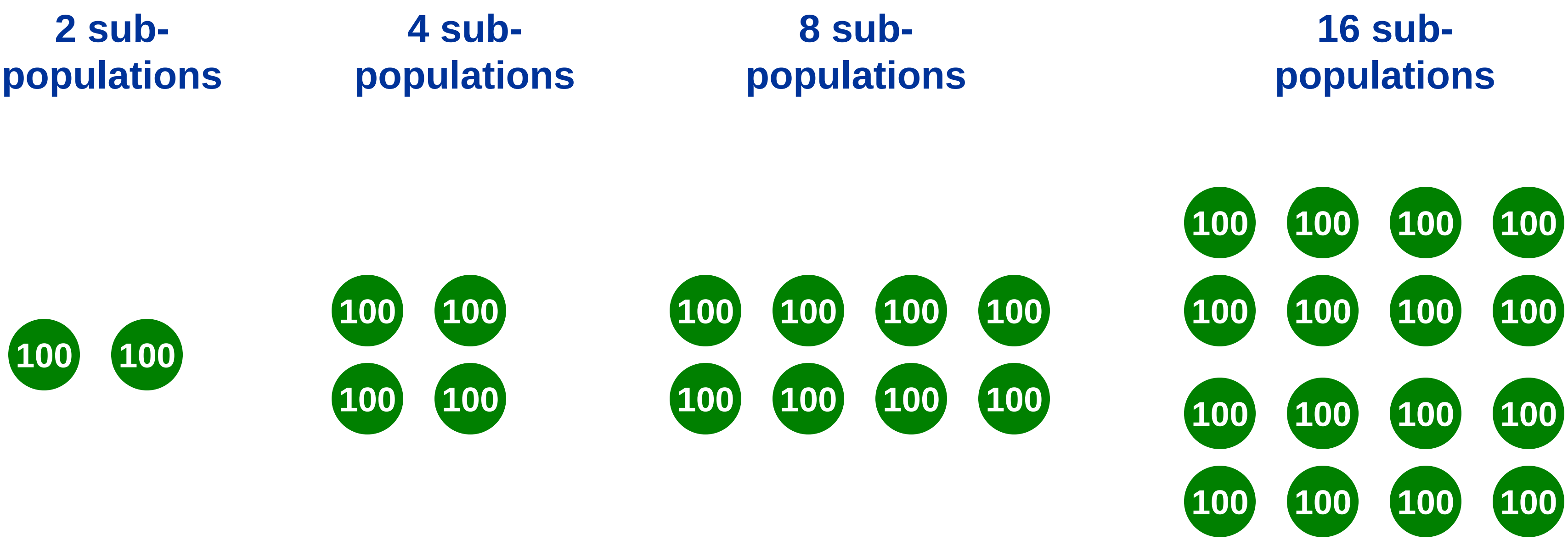
Synthetic ‘landscapes’ of isolated ponds with the same subpopulation sizes, *n*=100



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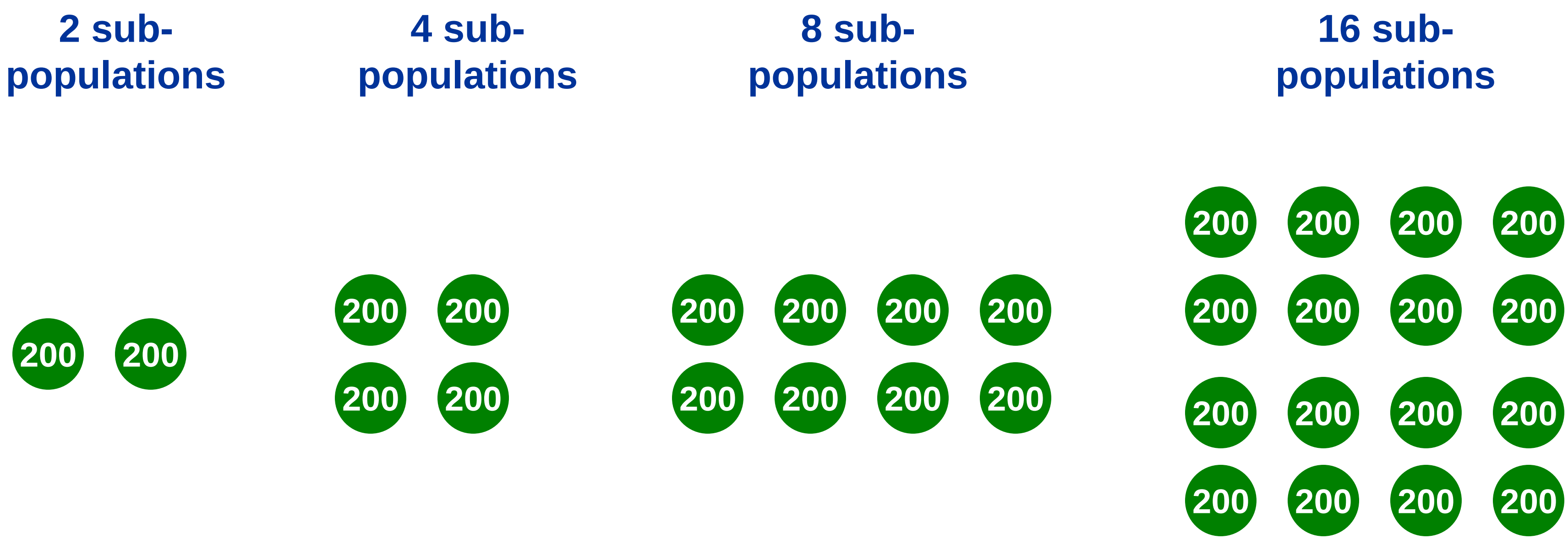
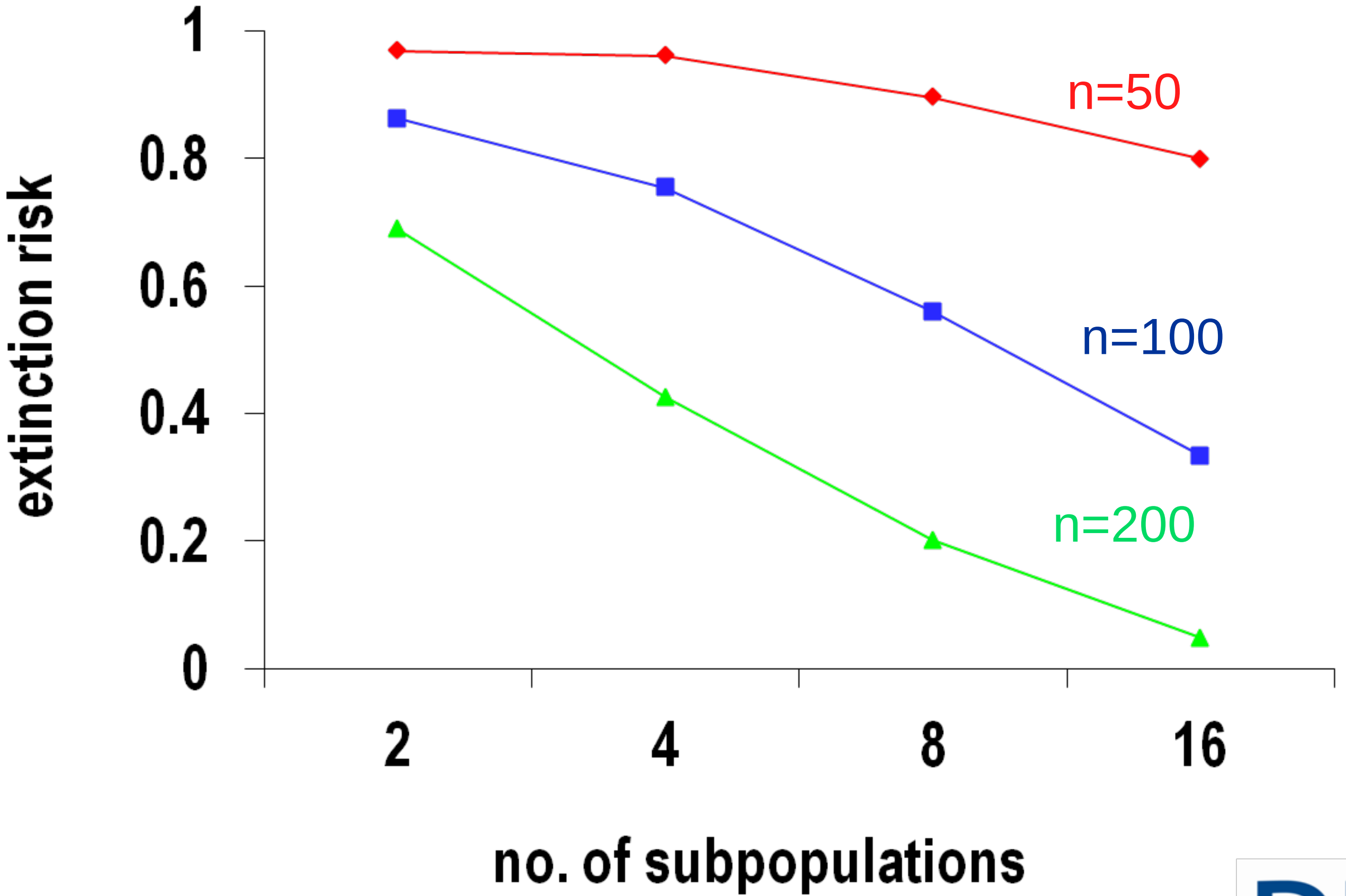
Synthetic 'landscapes' of isolated ponds with the same subpopulation sizes, *n*=200



Extinction risk of groups of isolated subpopulations

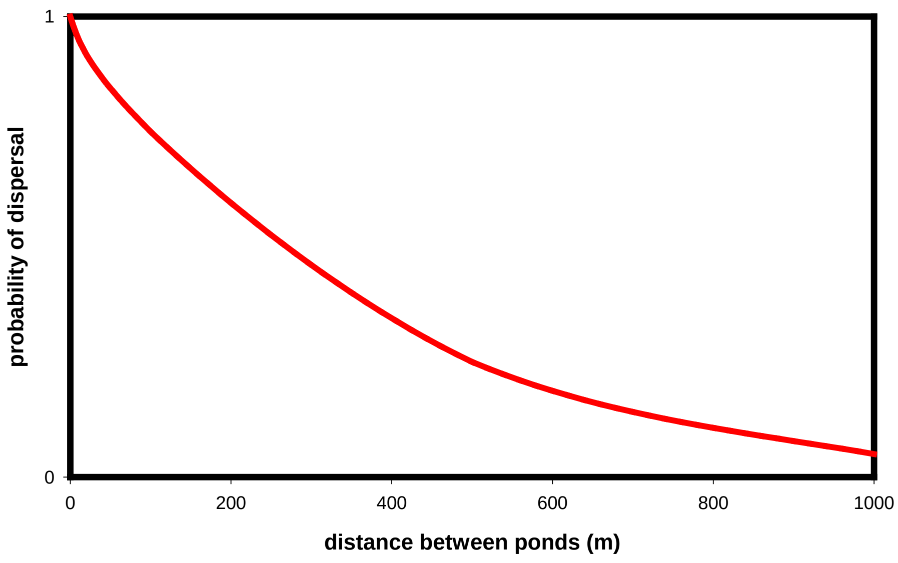


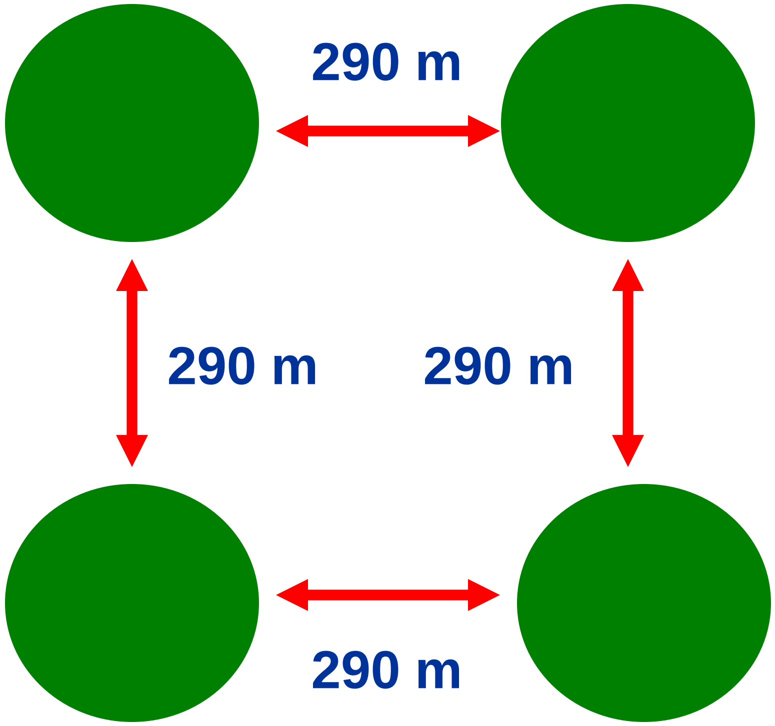
Modelling dispersal of crested newts

Dispersal stage: **1-2 yr old newts**

Mean dispersal distance **= 290 m**

Maximum dispersal distance **= 1000 m**





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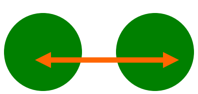
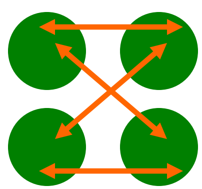
Synthetic ‘landscapes’ of ponds linked by juvenile dispersal

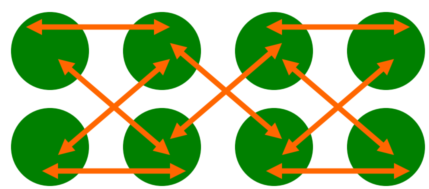
2 sub-populations



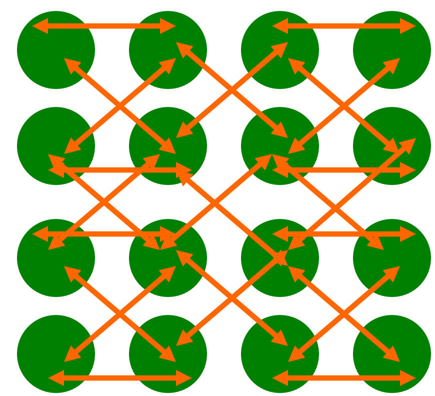
4 sub-populations



8 sub-populations



16 sub-populations



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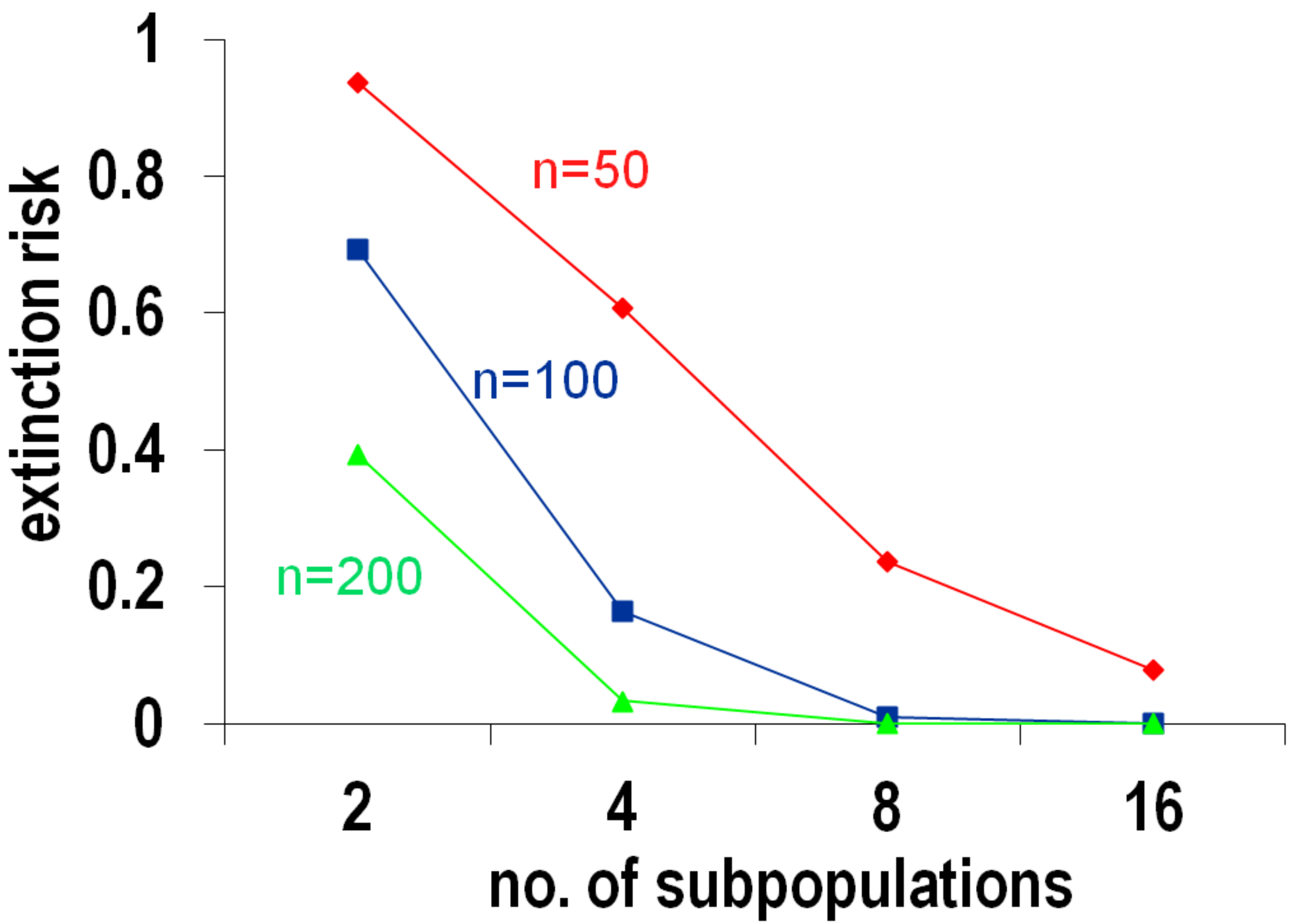
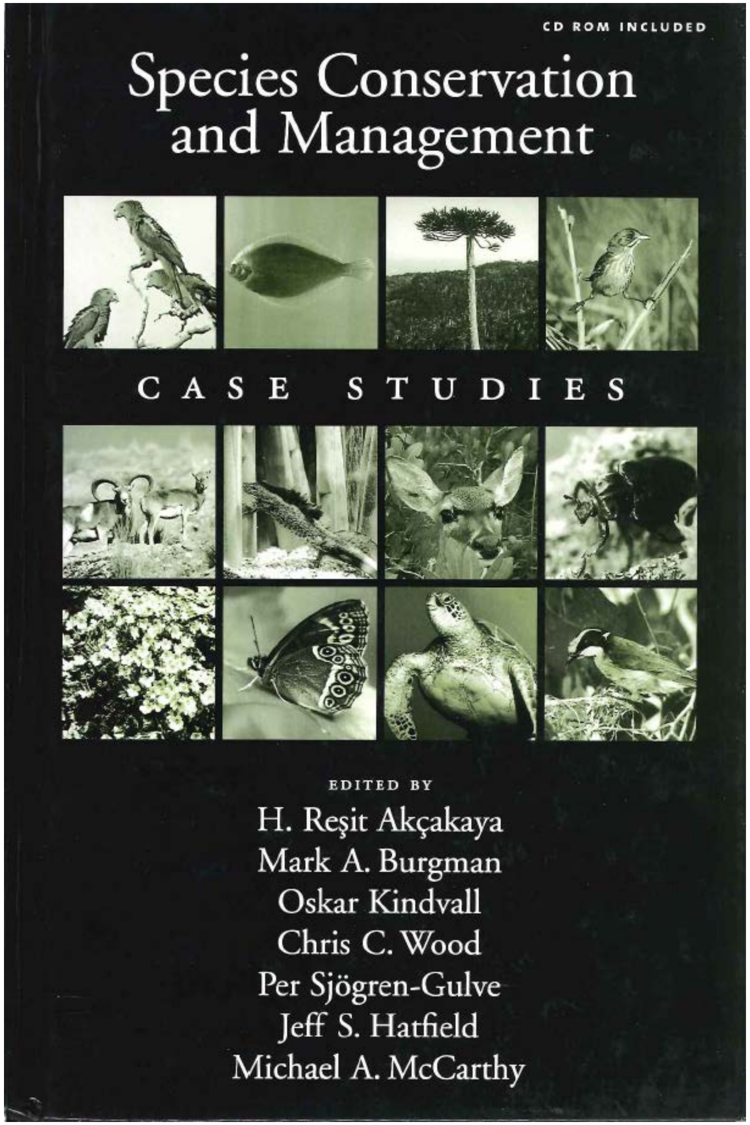
Extinction risk of groups of subpopulations connected by juvenile dispersal





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Great Crested Newts (*Triturus cristatus*) in Europe

Effects of Metapopulation Structure and Juvenile Dispersal on Population Persistence

RICHARD A. GRIFFITHS

espite a resurgence of interest in amphibian declines that has resulted in a prolifera-on of population case studies in recent years (e.g., Richards et al. 1993, Kuzmin 1994, rost and Fellers 1996, Green 1997, Lips 1998), population viability analysis has not een widely used as a management tool for these species. Although a diverse group, hich encompasses species that are entirely aquatic as well as entirely terrestrial, am-hibians are frequently small, cryptic animals that are inconspicuous for a large part of eir life cycle. This makes many amphibian population studies problematic, and the etermination of reliable demographic parameters is difficult. The vast majority of mphibian population studies have therefore consisted of assessments of adults at breed-ig foci, as this phase of the life cycle is the one in which animals are most conspicu-us. Such breeding foci—usually at ponds, streams, or lakes—are spatially distinct units at are convenient for testing hypotheses about subdivided populations. As Marsh and renham (2000) point out, however, adopting a "ponds-as-patches" approach to am-hibian spatial dynamics may be oversimplistic, as apparent population turnovers may ccur for reasons other than stochastic processes. Indeed, such turnovers may be ulti-ately related to wider landscape-level factors. Population viability analysis can be used s a tool to explore the interaction between deterministic (e.g., pond desiccation, habi-t change, fish introductions) and stochastic processes in amphibian population dynam-s. Equally, it can also be used to cautiously explore some of the lacunae that exist in mphibian life history data, through sensitivity analyses of some of the more elusive emographic and environmental parameters.

The great crested newt (*Triturus cristatus*) is one of the best-studied amphibian spe-ies in Europe. It is a species that spends most of its life on land, but adults return to onds to breed for a few months in the spring and early summer. Eggs are individually

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