Echinococcus multilocularis in Europe: still emerging?
- the animal perspective -

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What is an emerging disease?

- new in the population

- increasing geographic range

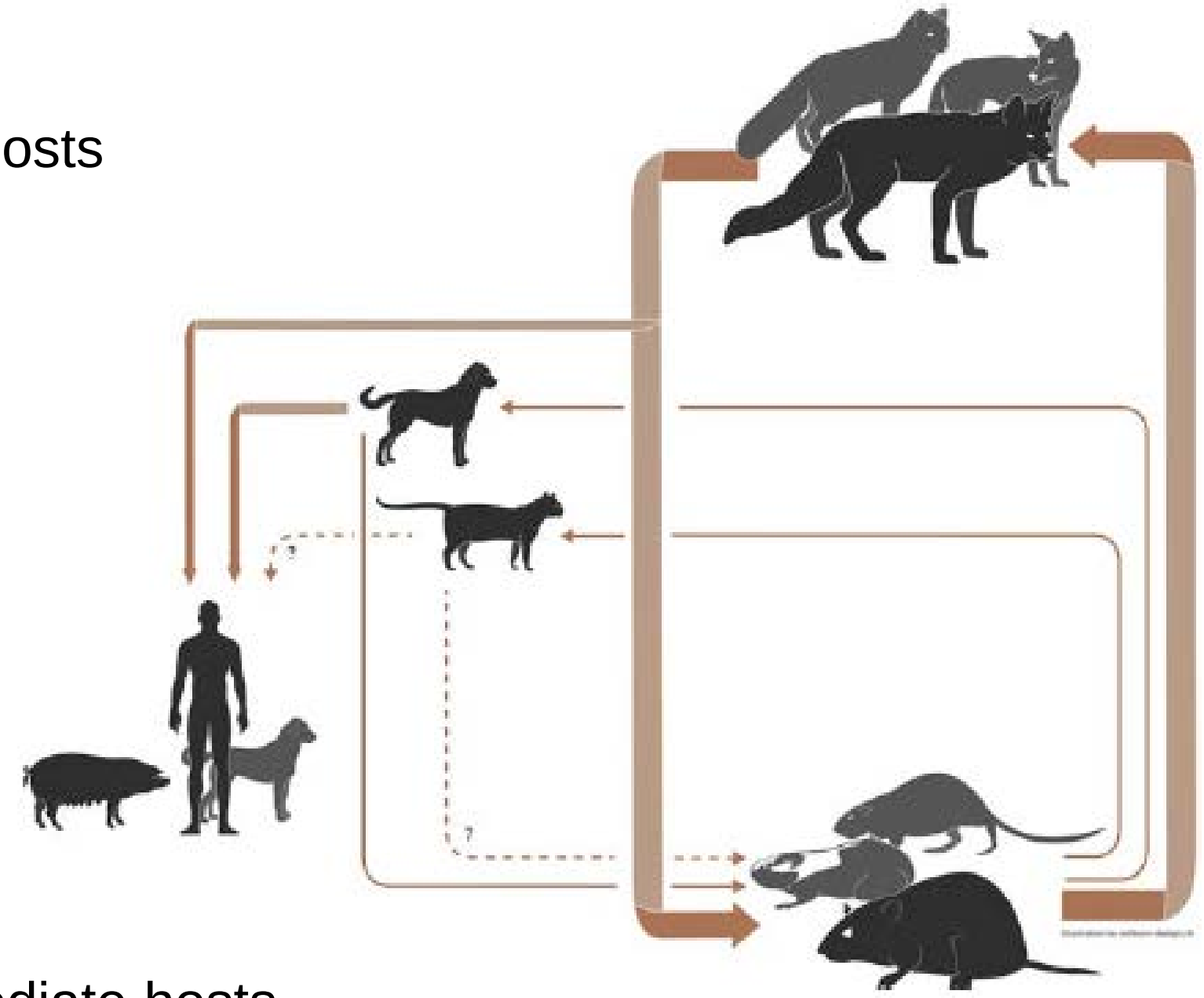
- increasing frequency

- increasing recognition

The term ED is generally applied to human disease, based on case numbers.

What is happening with the life cycle of the parasite?

Definitive hosts

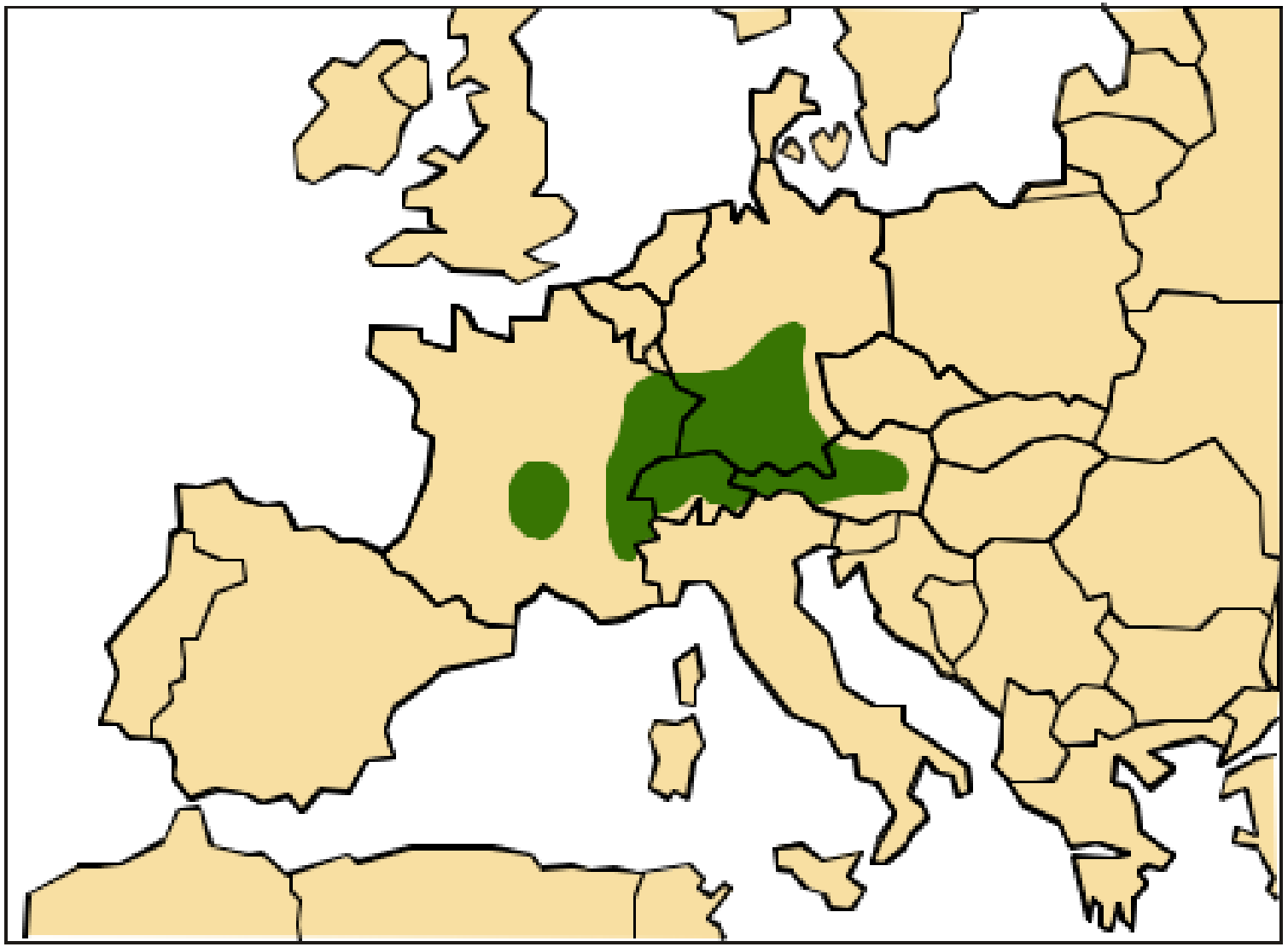


Intermediate hosts

Romig et al., 2017

Geographic Range

< 1990

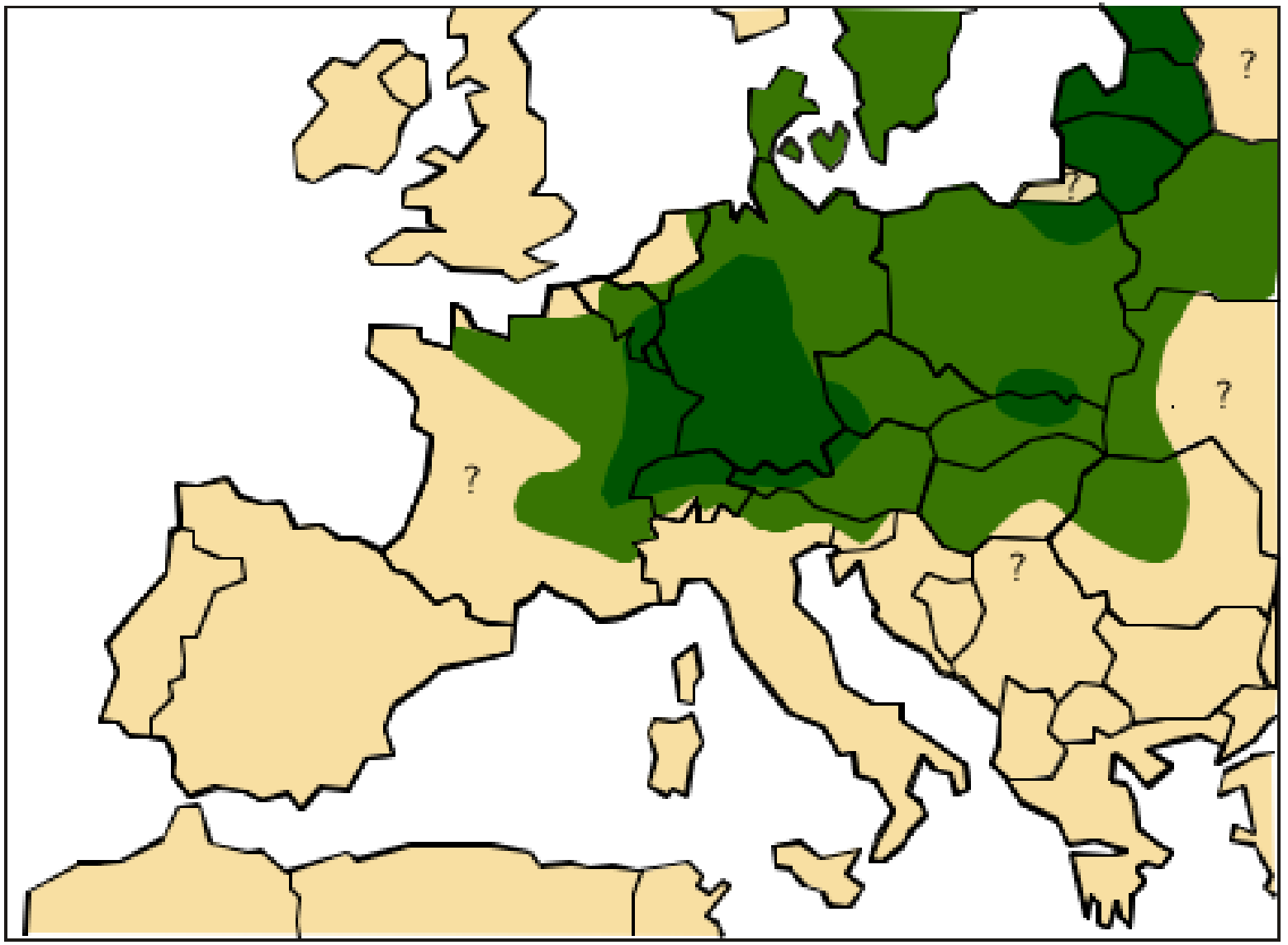


Fesseler, 1990

Geographic Range

approx. 2015

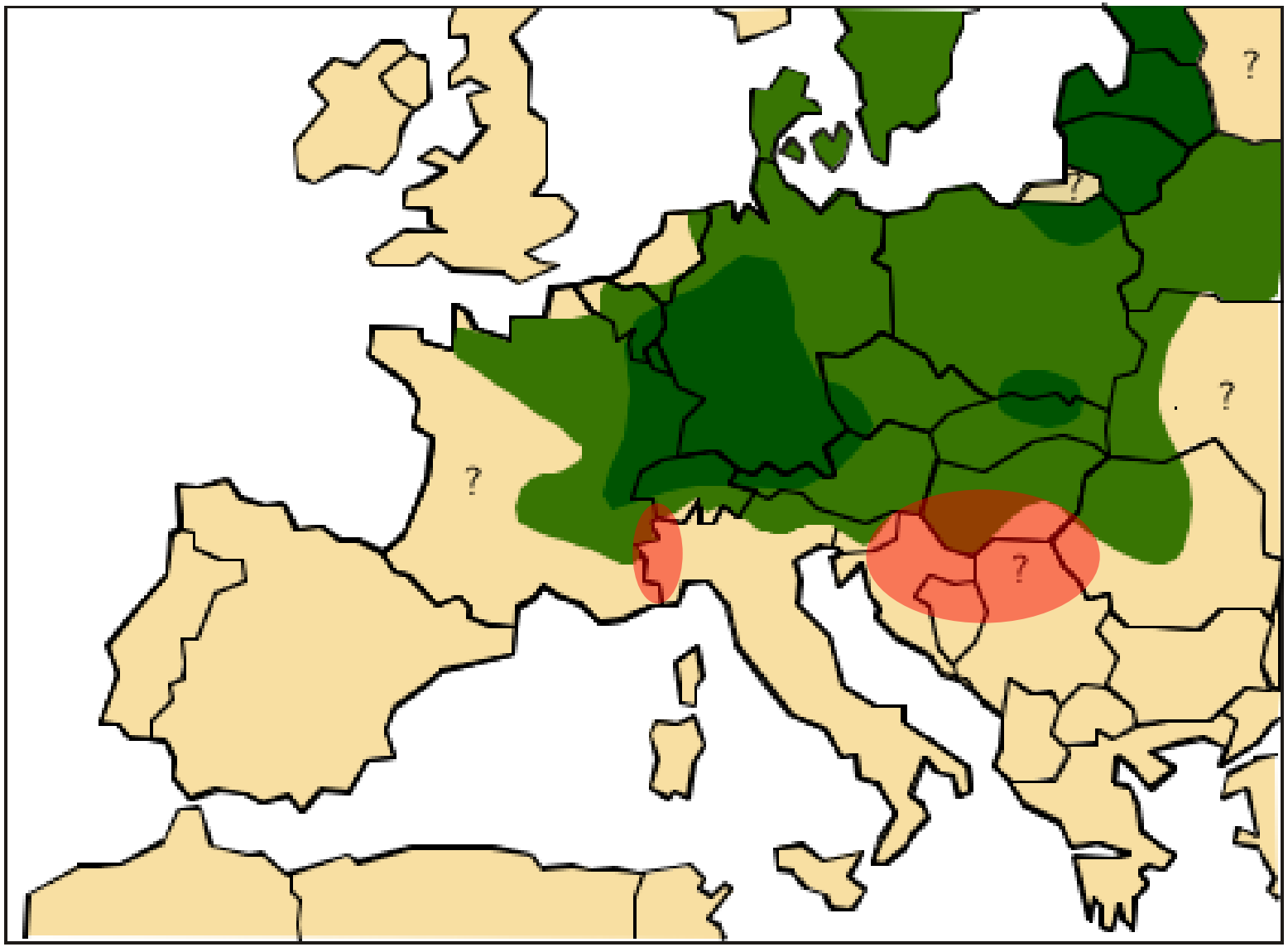
Expansion or new recognition?



Geographic Range

recent data

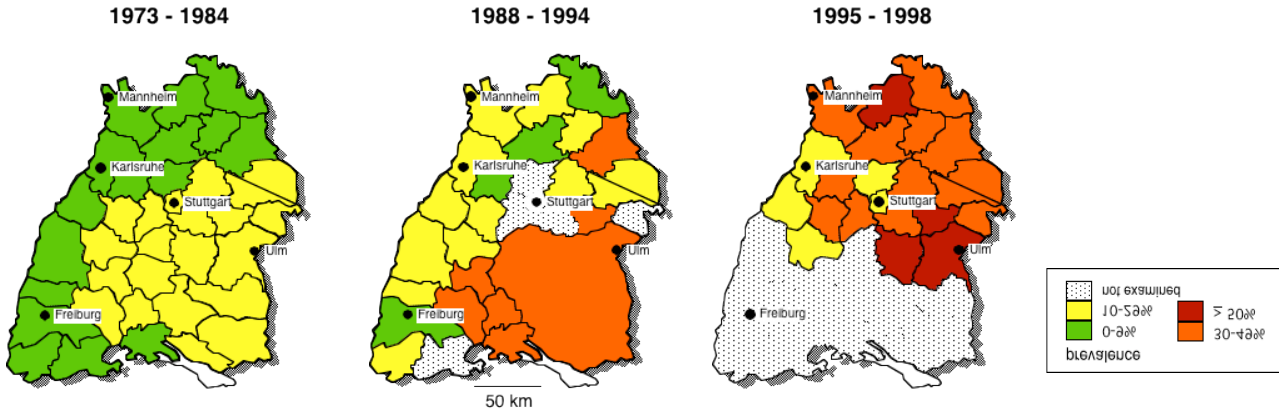
Expansion or new recognition?

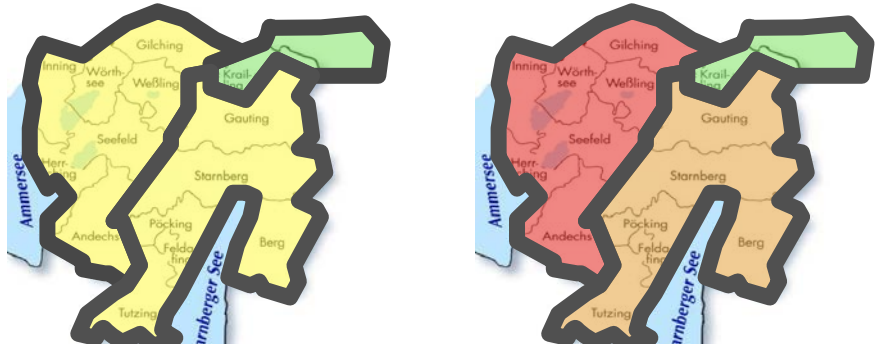


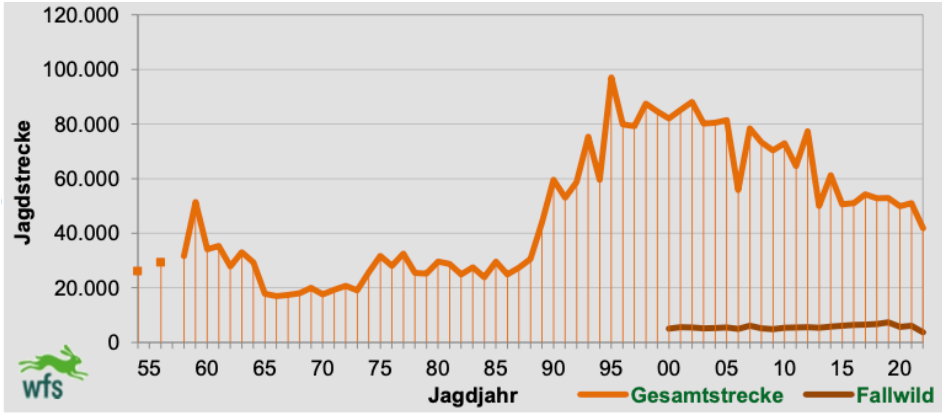
Beck et al., 2017; Lalosevic et al., 2016; Massolo et al., 2018; Omeragic, 2022; Umhang et al., 2016, 2021

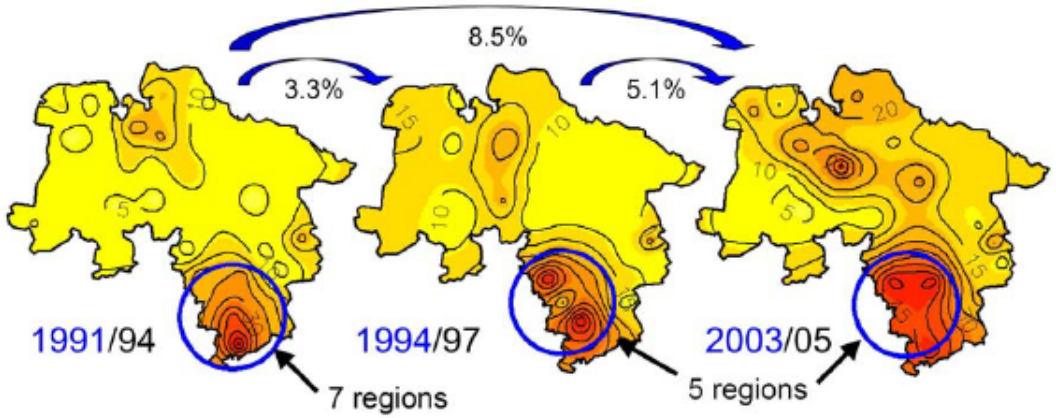
Increasing prevalence

Central Europe: massive increase of parasite abundance during the 1990s (approx. factor 10)







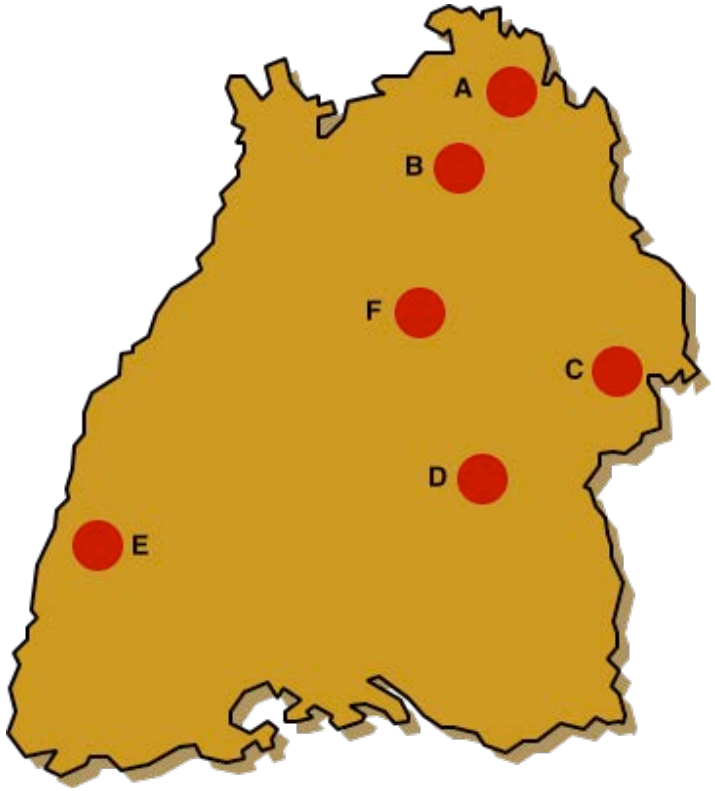


Berke et al., 2008; König et al., 2005; Romig et al., 2002

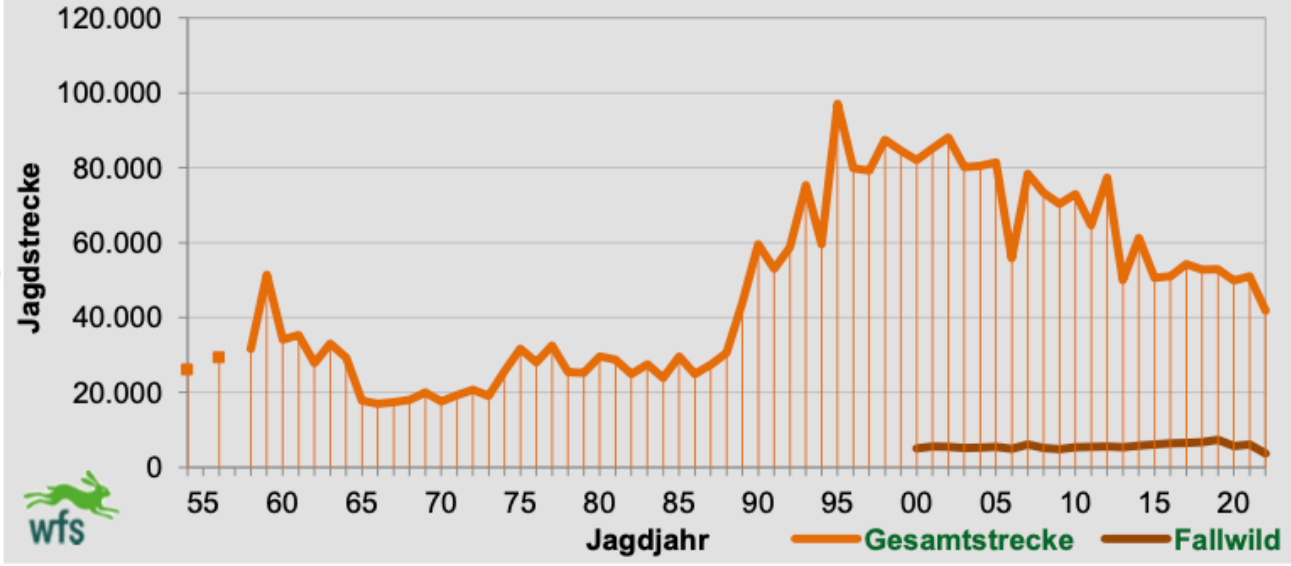
Prevalence in muskrats

	1980-1989	**1995-2000**
A Tauber	**0,0%** (123)	**25,6%** (78)
B Kocher, Jagst	**0,5%** (778)	**30,8%** (468)
C Brenz	**2,8%** (358)	**20,3%** (143)
D div.	**4,1%** (713)	**14,8%** (61)
E div.	**0,8%** (1316)	**22,0%** (150)
F Neckar	**3,8%** (131)	**23,4** (47)

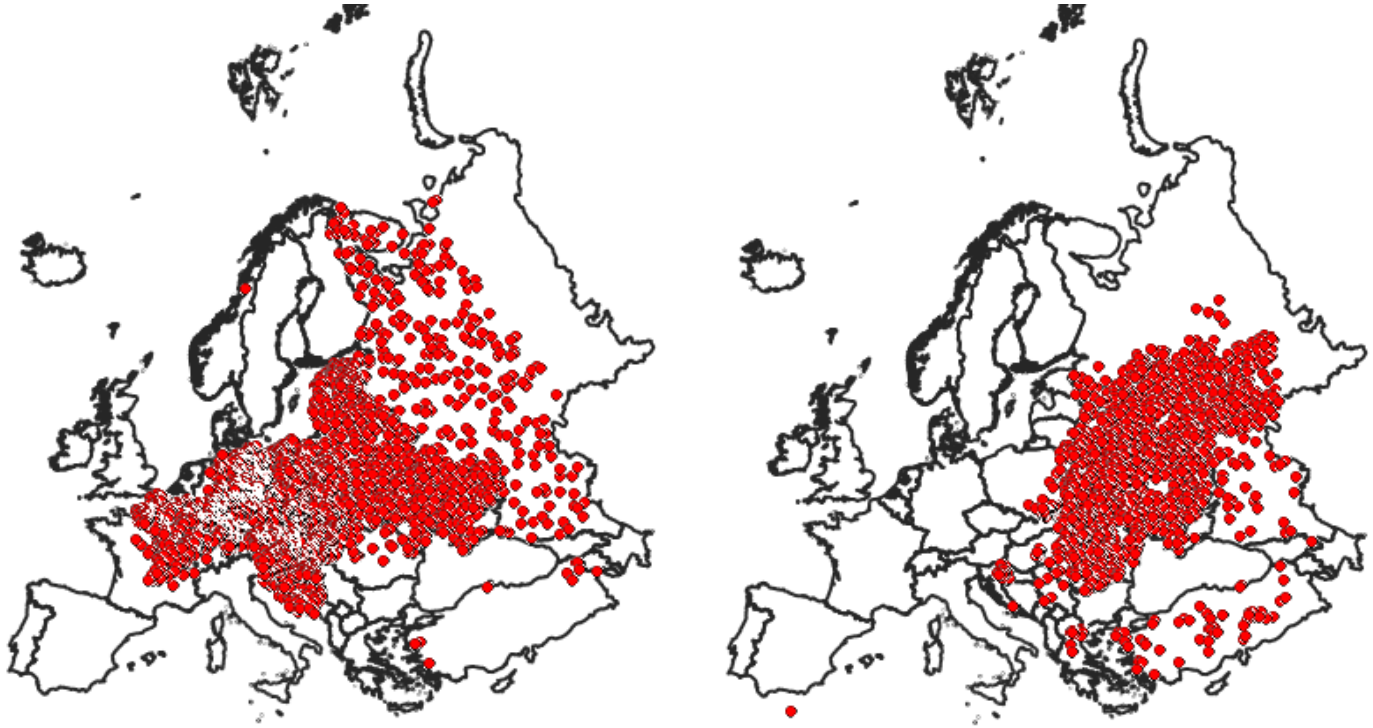
Romig et al., 2002



Correlation with fox population increase following rabies elimination



Fox rabies 1990 and 2013



FLI Rabies Bulletin; Wildforschungsstelle Baden-Württemberg 2023

The emergence of *E. multilocularis* in the 1990s was primarily driven by a drastic increase of **definitive host (fox) populations** and linked to the removal of **a single limiting factor** (rabies mortality).

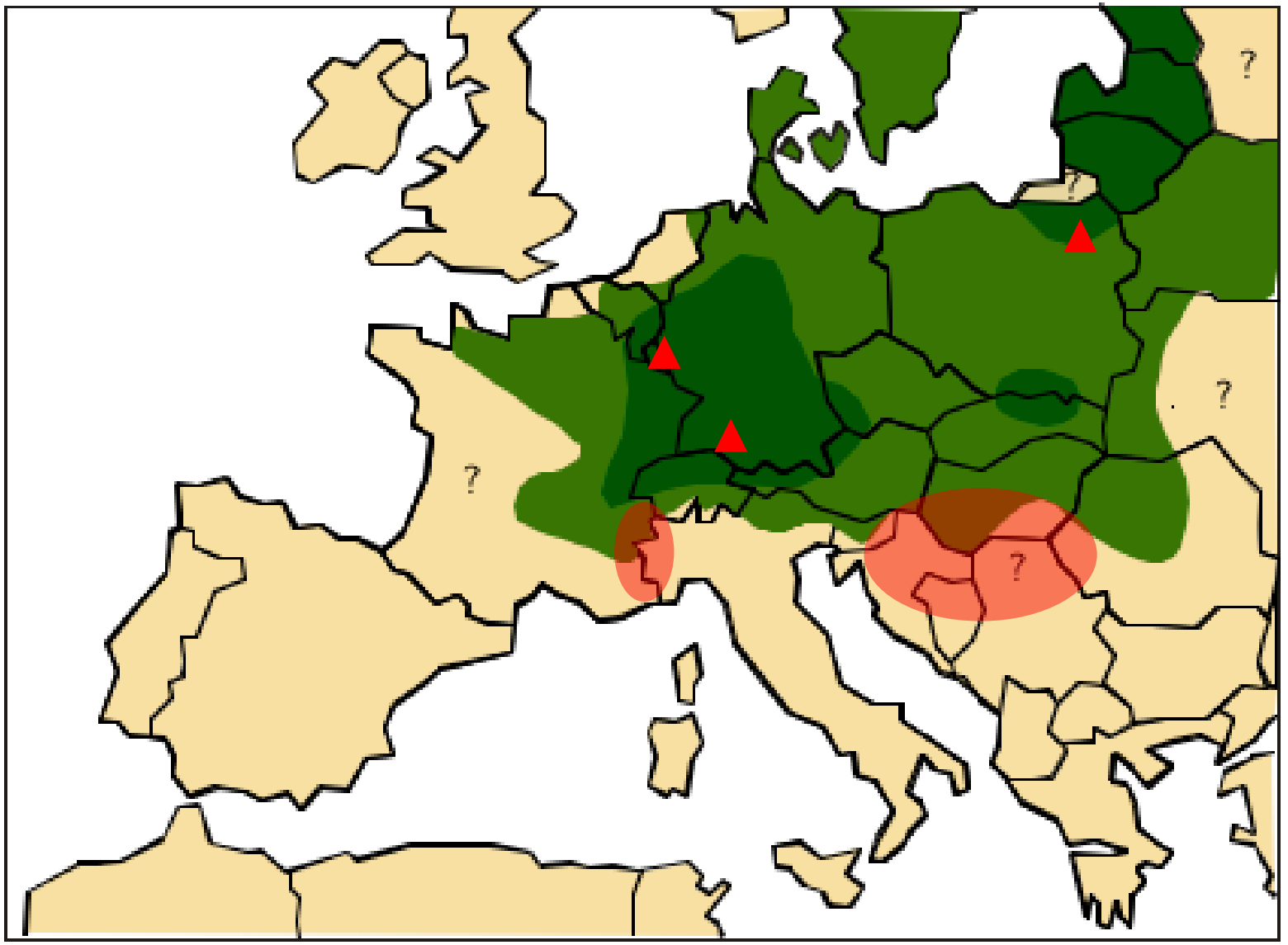
Recent changes?

Highly endemic areas

SW-Germany
1973-1984: <10%
1993-1994: 44.8%
2018-2020: 41.3 – 50.1%

Luxembourg
1990-1992: 5.1%
2001-2005: 21.6%
2006-2013: 25.9%

Eastern Poland
1995-2000: 1.0-18.8%
2001-2004: 36.8-39.6%
2011-2013: 39.3-42.7%



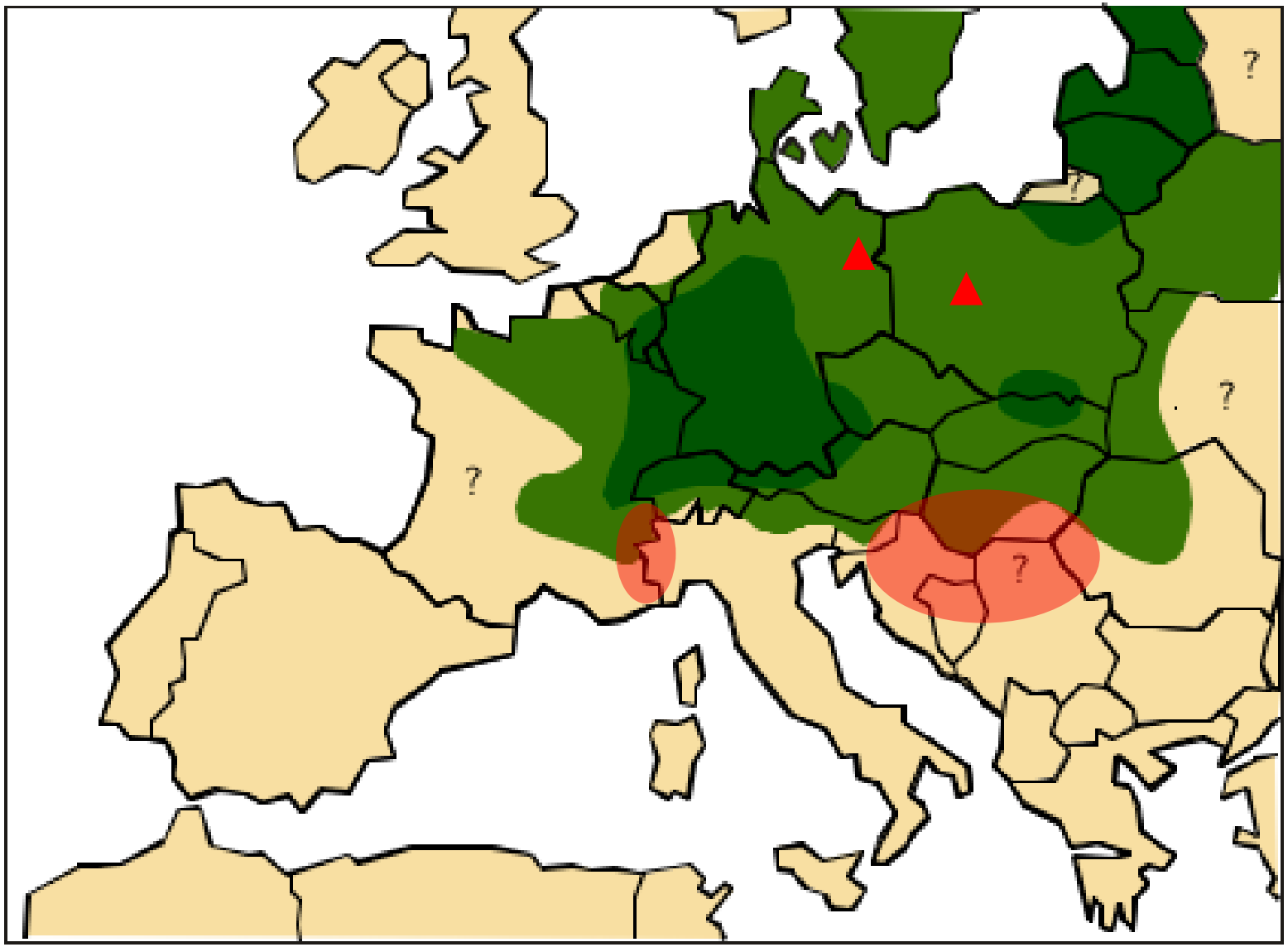
Ahlmann et al., 1996; Bilger et al., 1995; EFSA; Romig et al., 2002; Schneider et al., 2023

Recent changes?

Low endemic areas

NE-Germany
1992-1995: 4.9-23.8%
2017: 1.4%

Central/western Poland:
1995-2000: 0.6-7.3%
2001-2004: 7.9%
2011-2013: 0.0-0.9%



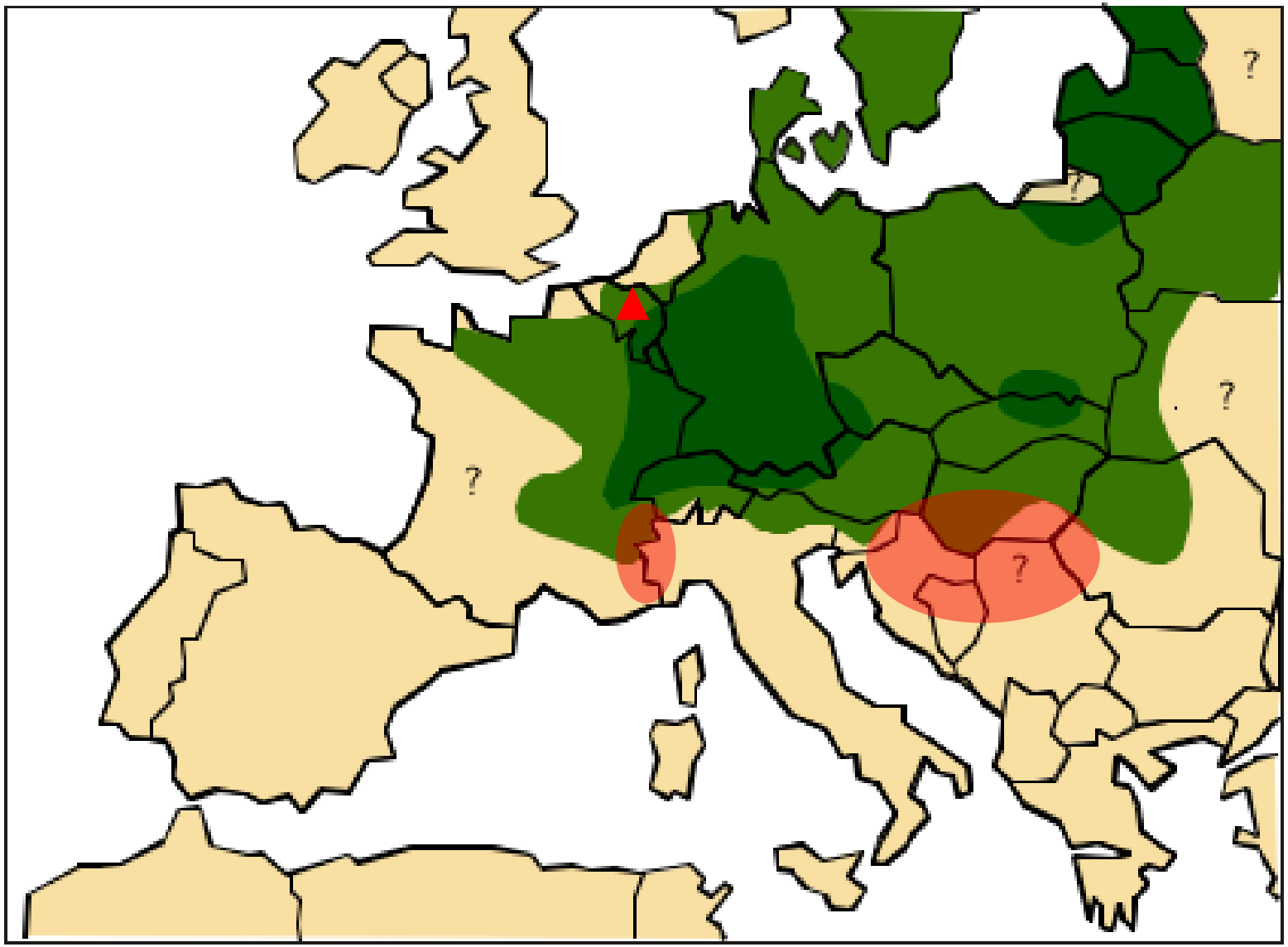
Karamon et al., 2018; Malczewski et al., 2008; Schuster & Shimalov, 2017; Tackmann et al., 2004

Recent changes?

Northwestern border

Northern Belgium
1996-1999: 1.7%
2007-2008: 0.0%
2012-2015: 2.1%

Southern Belgium
1991: 15.3%
1993-1995: 51.0%
1998-2002: 20.2%
2003-2004: 24.5%



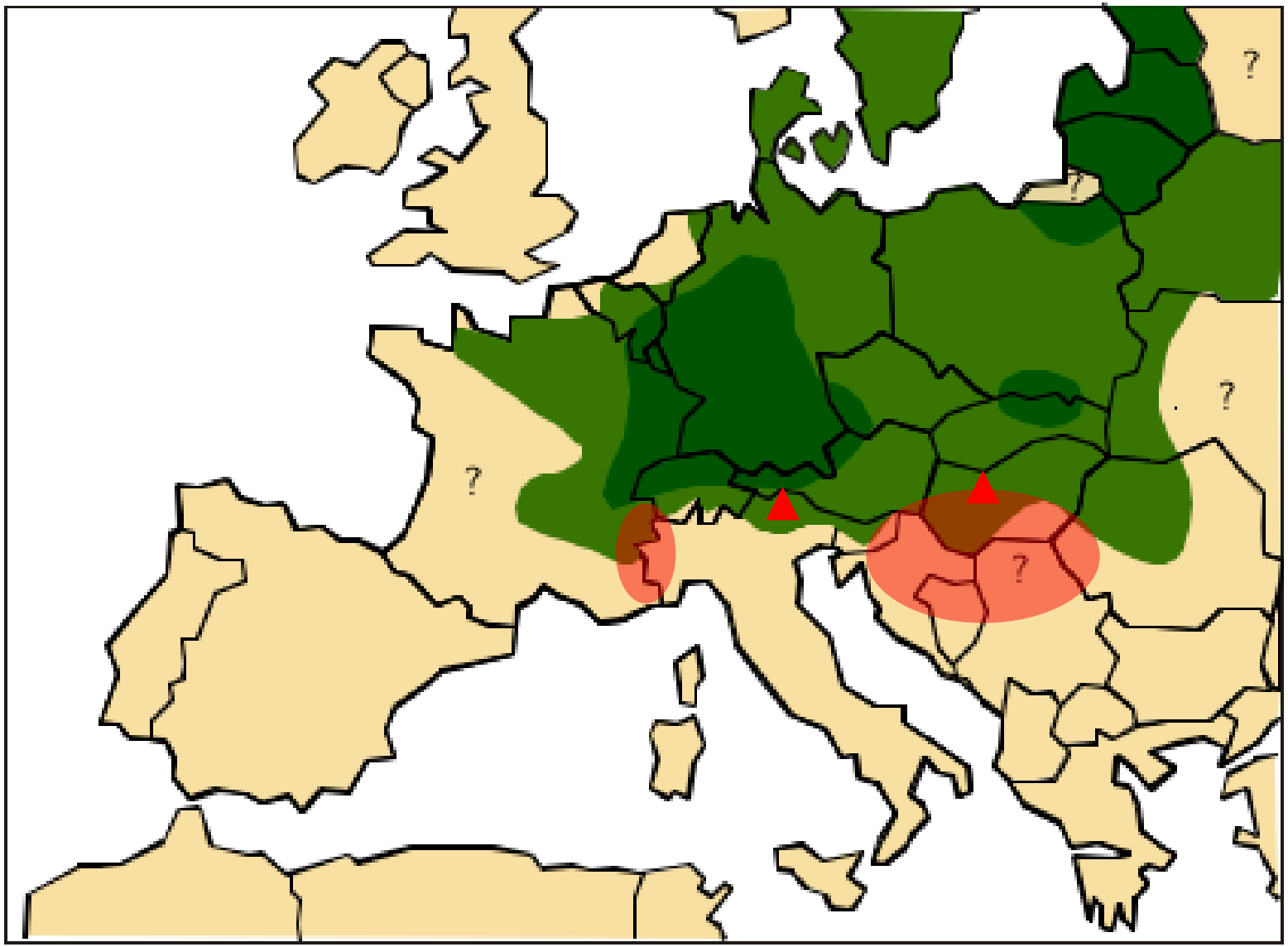
Brochier et al., 1992; Hanosset et al., 2008; Jansen et al., 2020; Losson et al., 1997; Losson et al., 2003; Van Gucht et al., 2009; Vervaeke et al., 2003

Recent changes?

Southern border

NE Italy
2001-2004: 12.9%
2012-2018: < 5.0%
2019-2020: 14.3%

Hungary
2008-2009: 10.7%
2012-2013: 7.9%



Casulli et al., 2005; Citterio et al., 2021; Obber et al., 2022; Tolnai et al., 2013

EU One Health Zoonoses Reports:

2016	19.4%
2017	16.9%
2018	17.8%
2019	13.7%
2020	16.1%
2021	15.7%
2022	12.5%

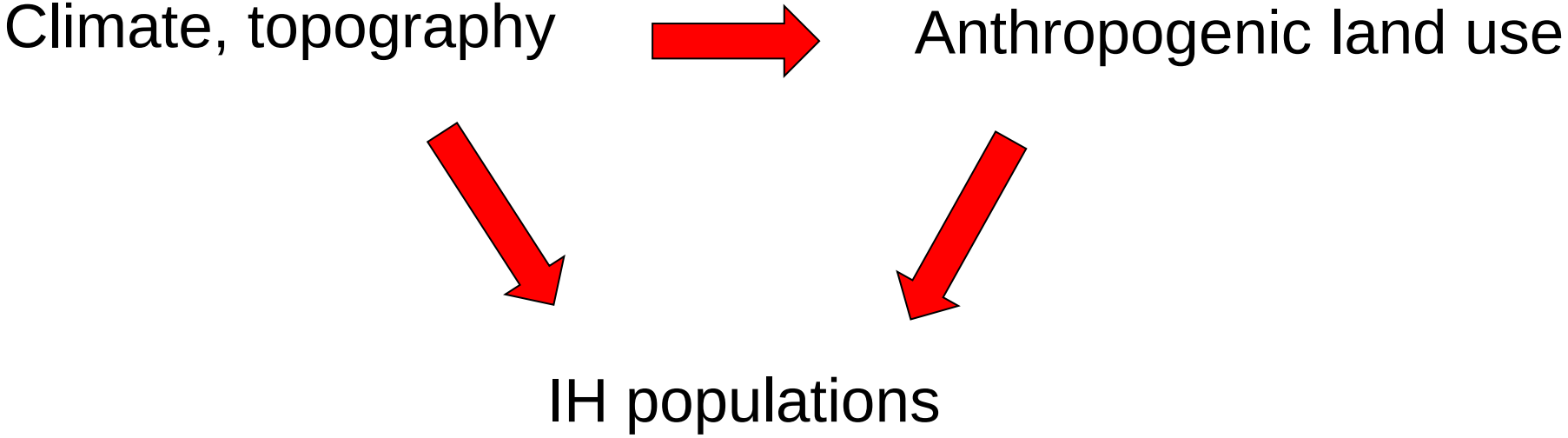
For the previous two decades, **no further emergence** is detectable in the largest part of the European endemic area on the animal host side.

This must not be true for small-scale foci and for **fringe areas e.g. in the South** of the endemic region, where further monitoring is necessary.

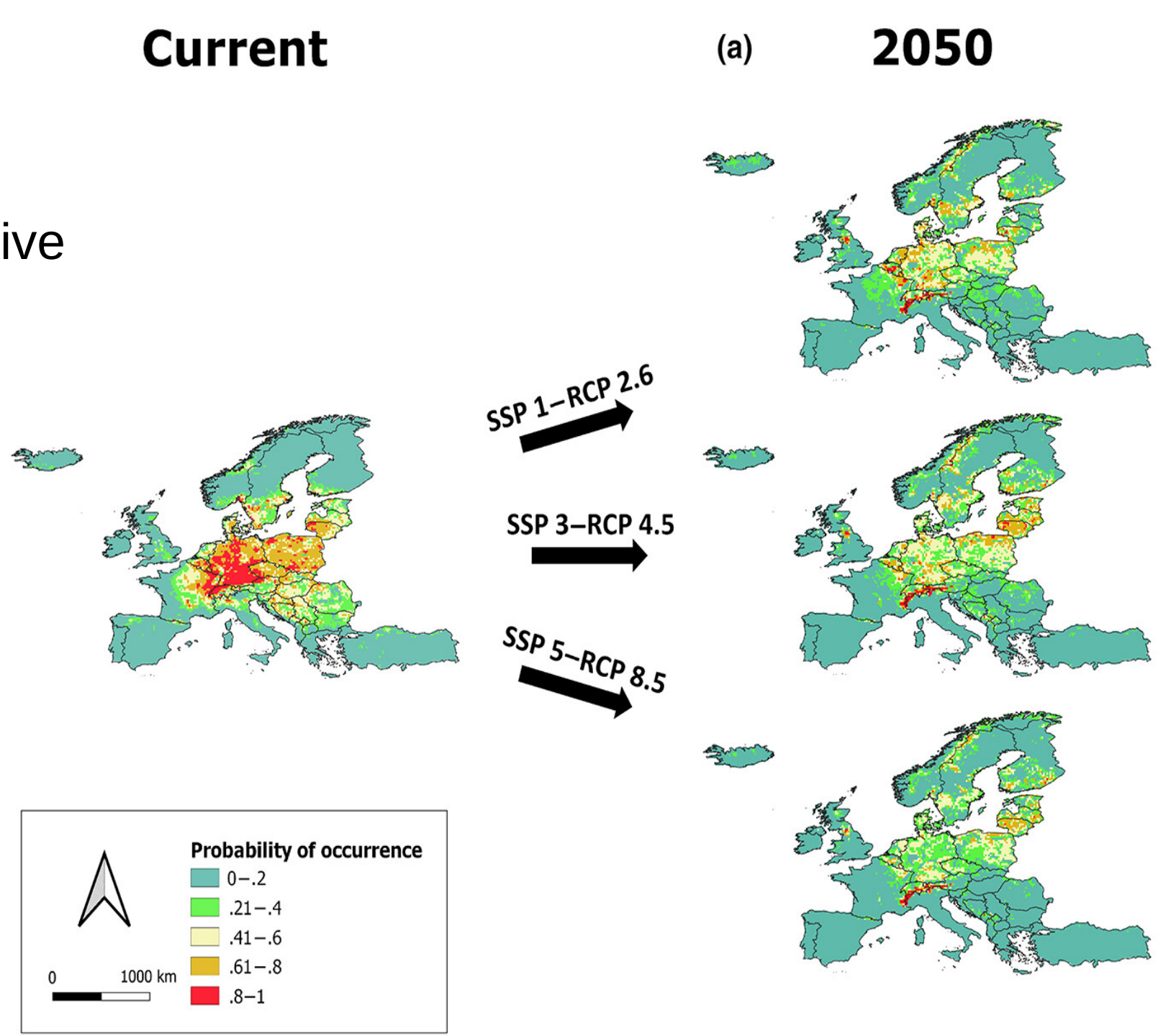
Within Europe, there is strong **geographical structuring into high, low and non-endemic areas**.

This structuring appears **temporally stable**, but there is data deficiency.

The geographical structuring is linked to climatic, topographical and ecological factors (elevation, precipitation, land use), which act on populations of competent **intermediate host (rodent) populations**.



Geographical structure is sensitive to climatic developments



Cenni et al., 2023

Take home:

Under current conditions, the life cycle in the core area is remarkably stable without further emergence, and may become even less intense in future.

There is some emergence in parts of the southern border areas, which may in future become more pronounced at higher elevations in the Alps.