# The use of species traits and the SPEAR metric to specifically assess pesticide impact on streams in Germany

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# Assessing pesticide impact on streams

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(1) What direct and indirect effects to stream biota are caused by pesticide exposures?

# Resistant species

# Vulnerable species

## Insensitive

*Pisidium sp.*

## Plurivoltine

*Chironomus sp.*

## Sensitive, univoltine

*Caloperyx sp.*



*Anabolia*

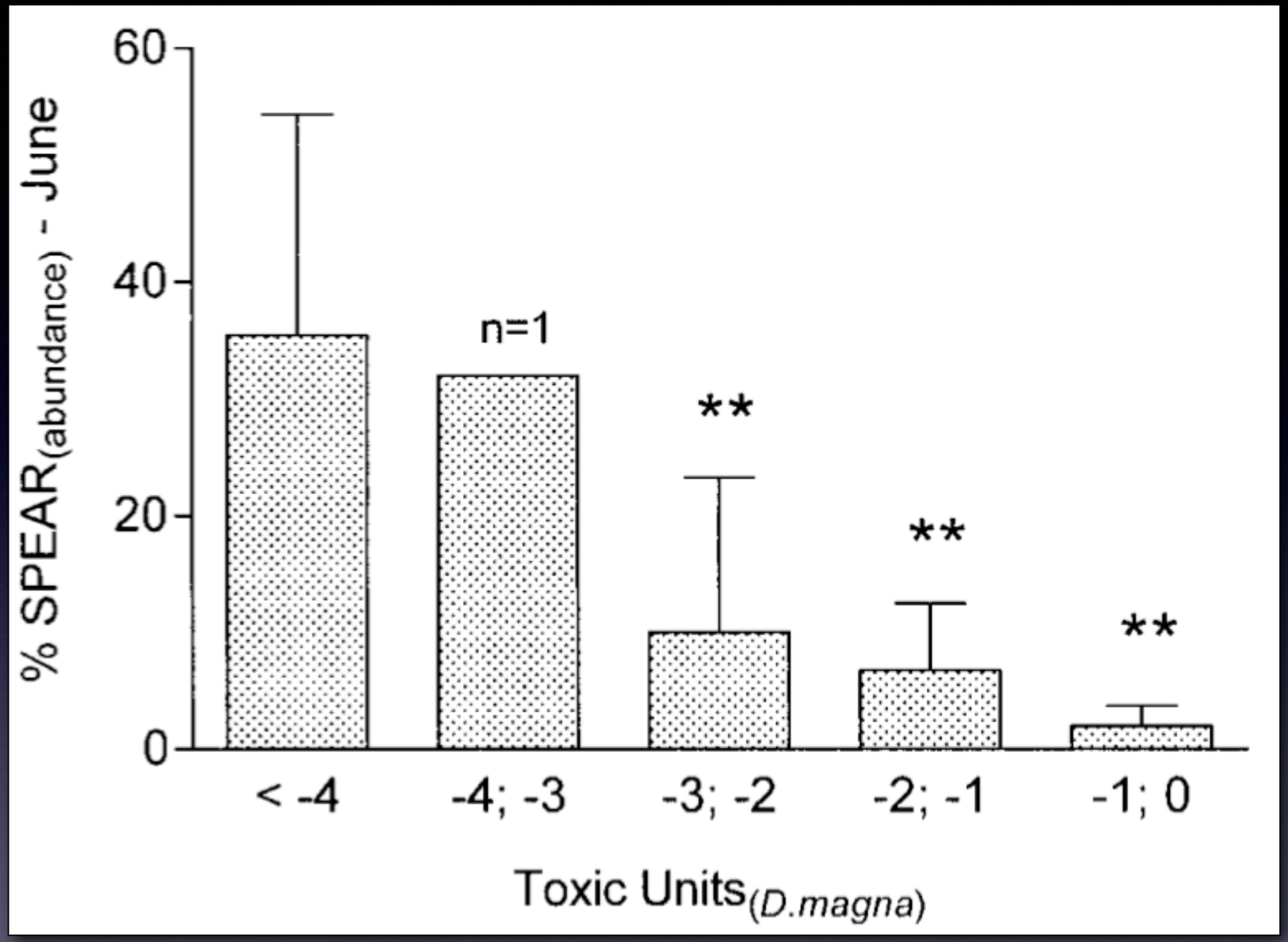
*Ephemera sp.*

## Migration

*Gammarus sp.*

## Early emergence

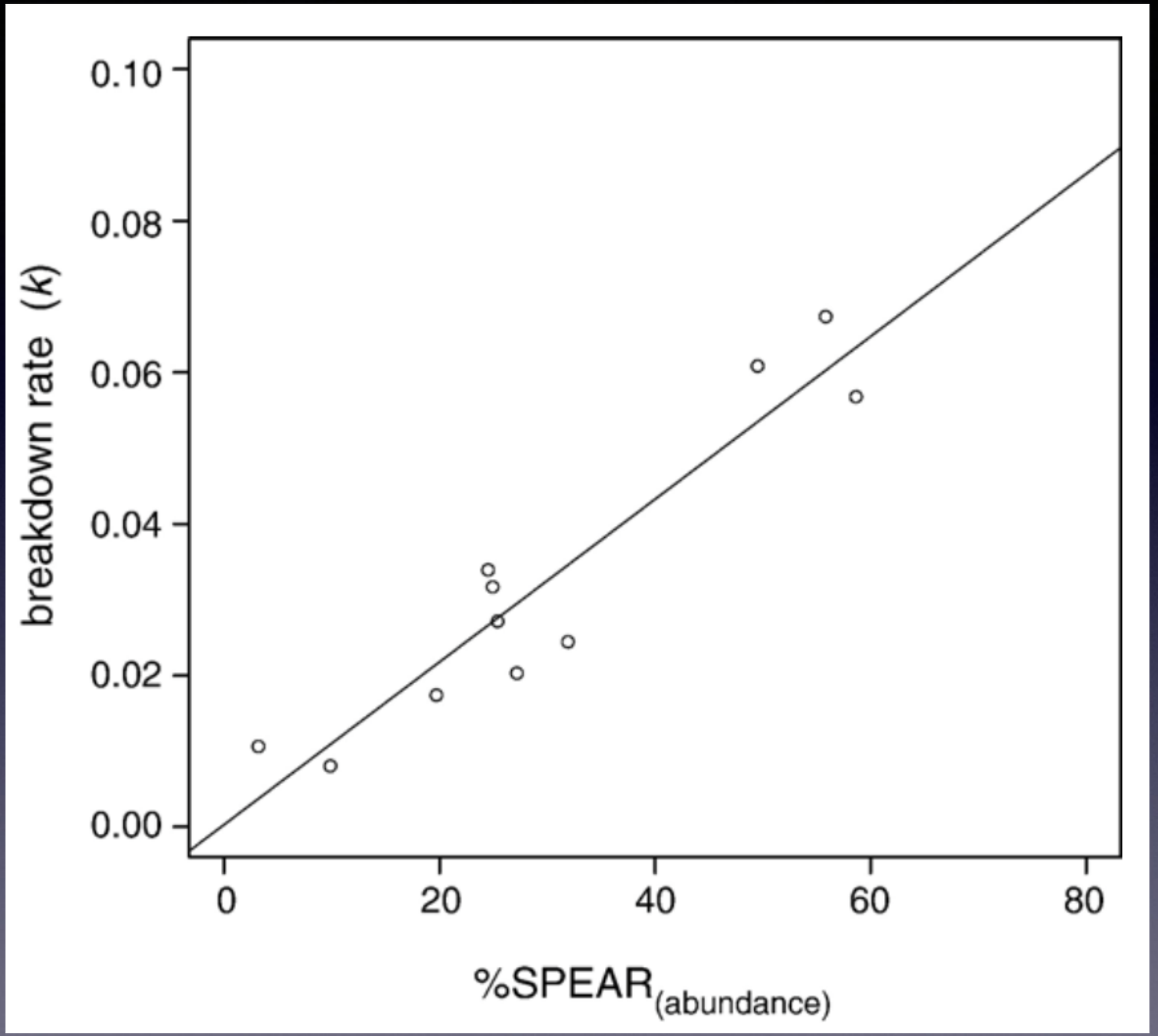
*Baetis sp.*




*Liess & v.d.Ohe 2005. ET&C*

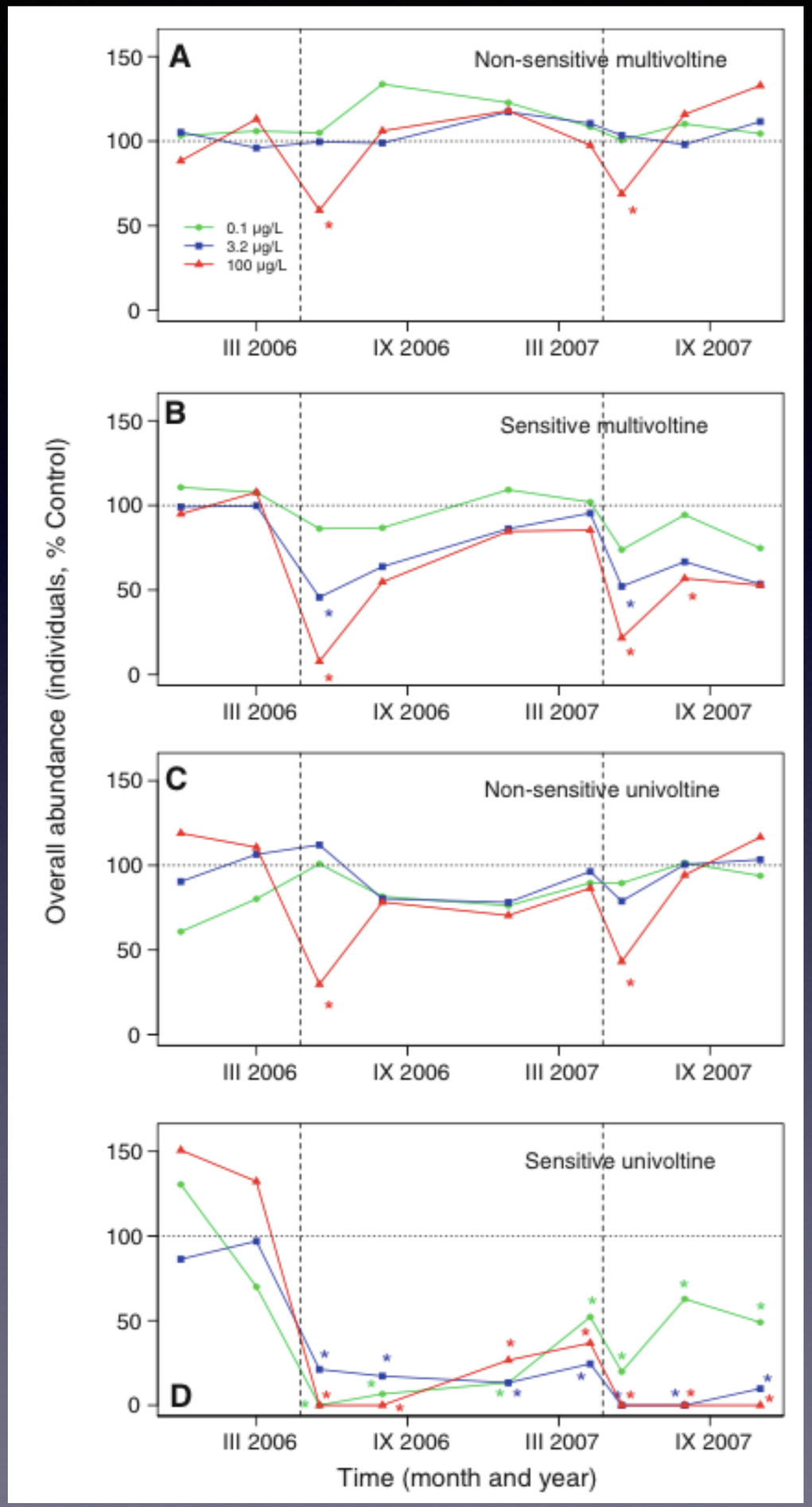
*also:*

***Liess M, et al.*** *2008 STOTEN*
***McKnight et al.*** *2012. ES&T*
***Schäfer et al.*** *2012. ES&T*
***Bunzel K, et al.*** *2013. Water Research*
***Rasmussen et al.*** *2013. STOTEN*
***Smetanováa S, et al.*** *2014. Environmental Pollution*




*Schäfer et al. 2007. STOTEN*

# Stream mesocosms




*Liess et al. 2011. Ecotoxicology*

(1) What direct and indirect effects to stream biota are caused by pesticide exposures?

- Biodiversity
- Degradation
- Plants?

(3) How do extrapolations
(i.e. tests —> field)
affect the reliability of the assessments?


Effect
Recovery
Trend

Effect

# Environmental Stress (UV)

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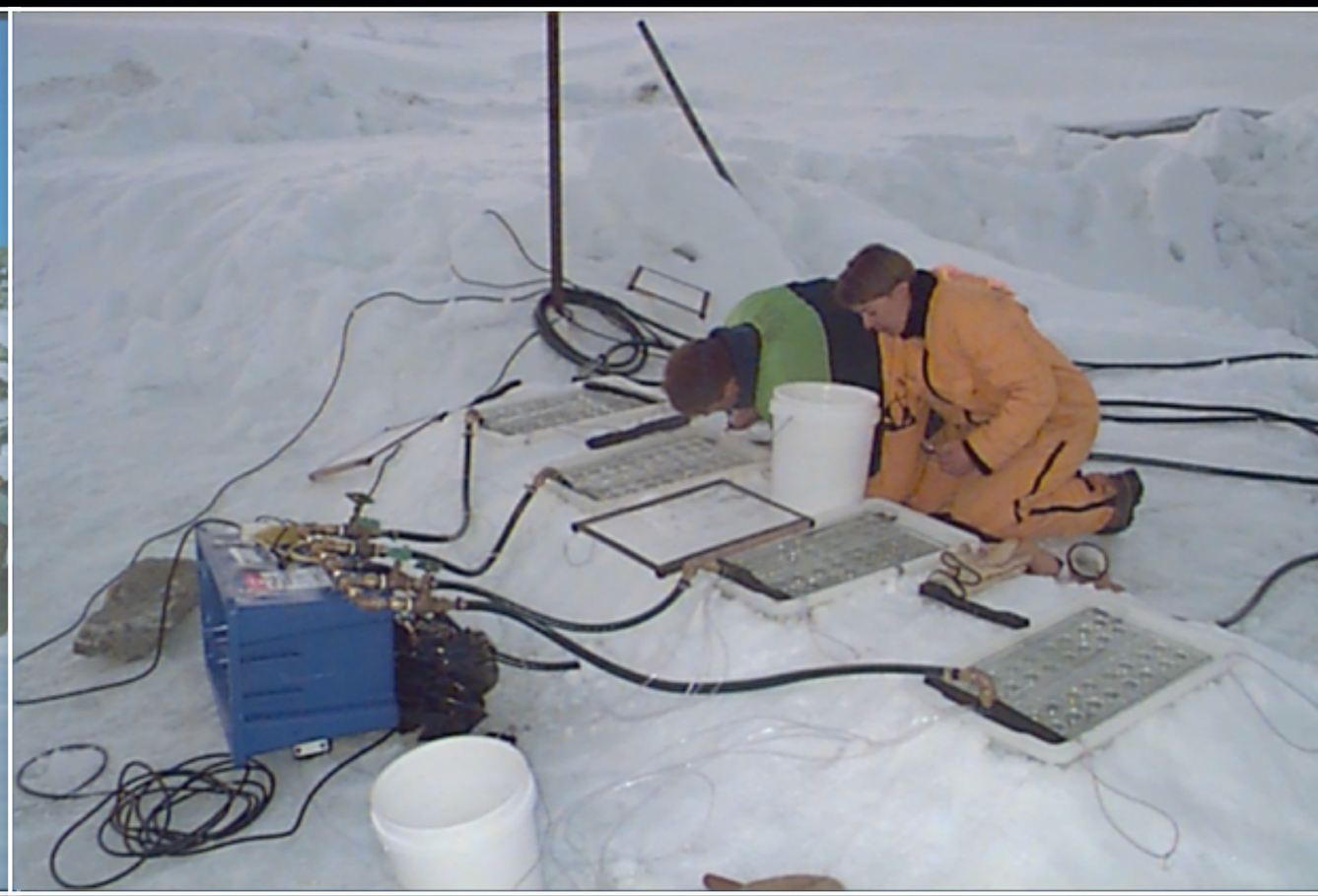
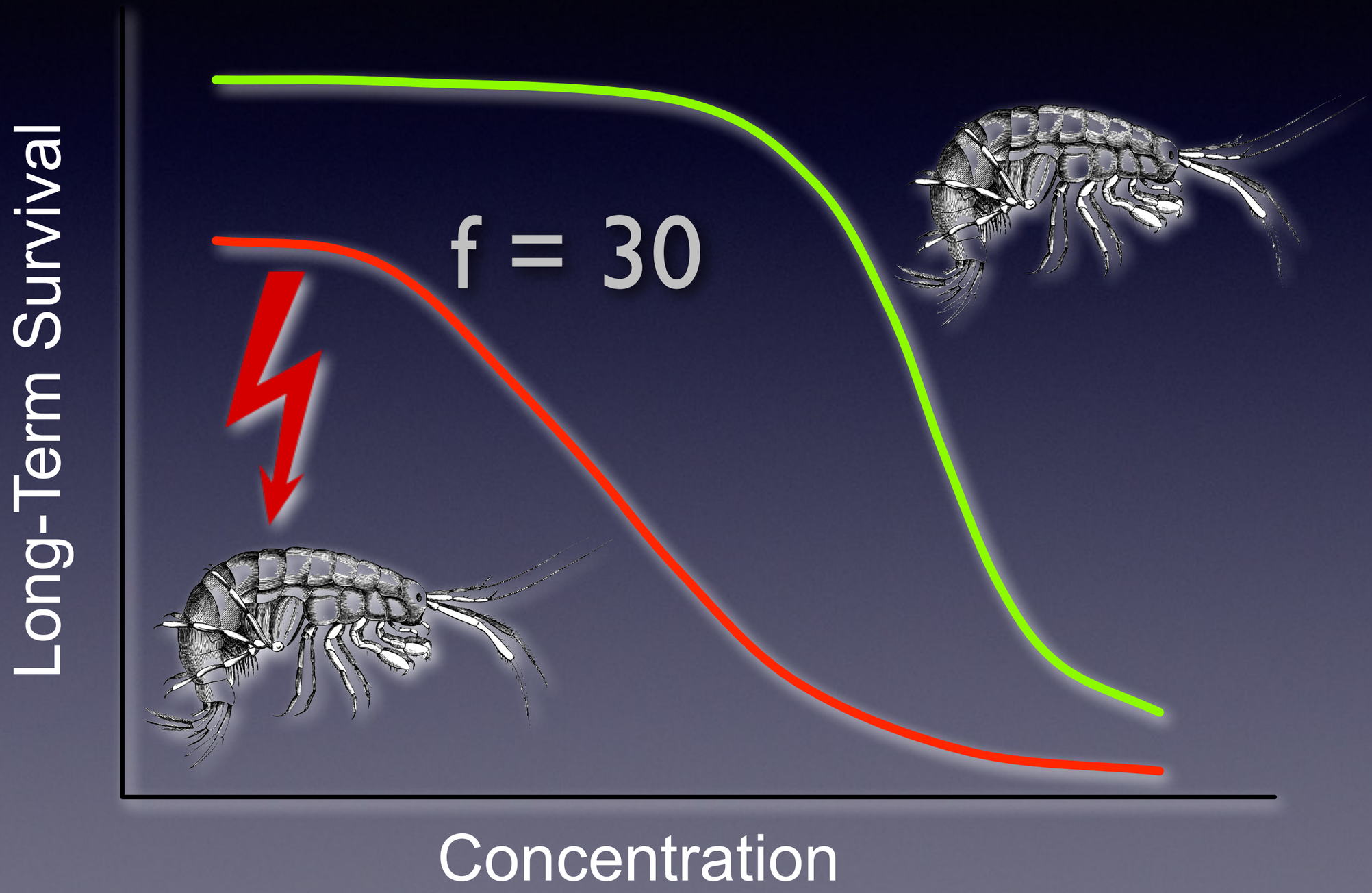
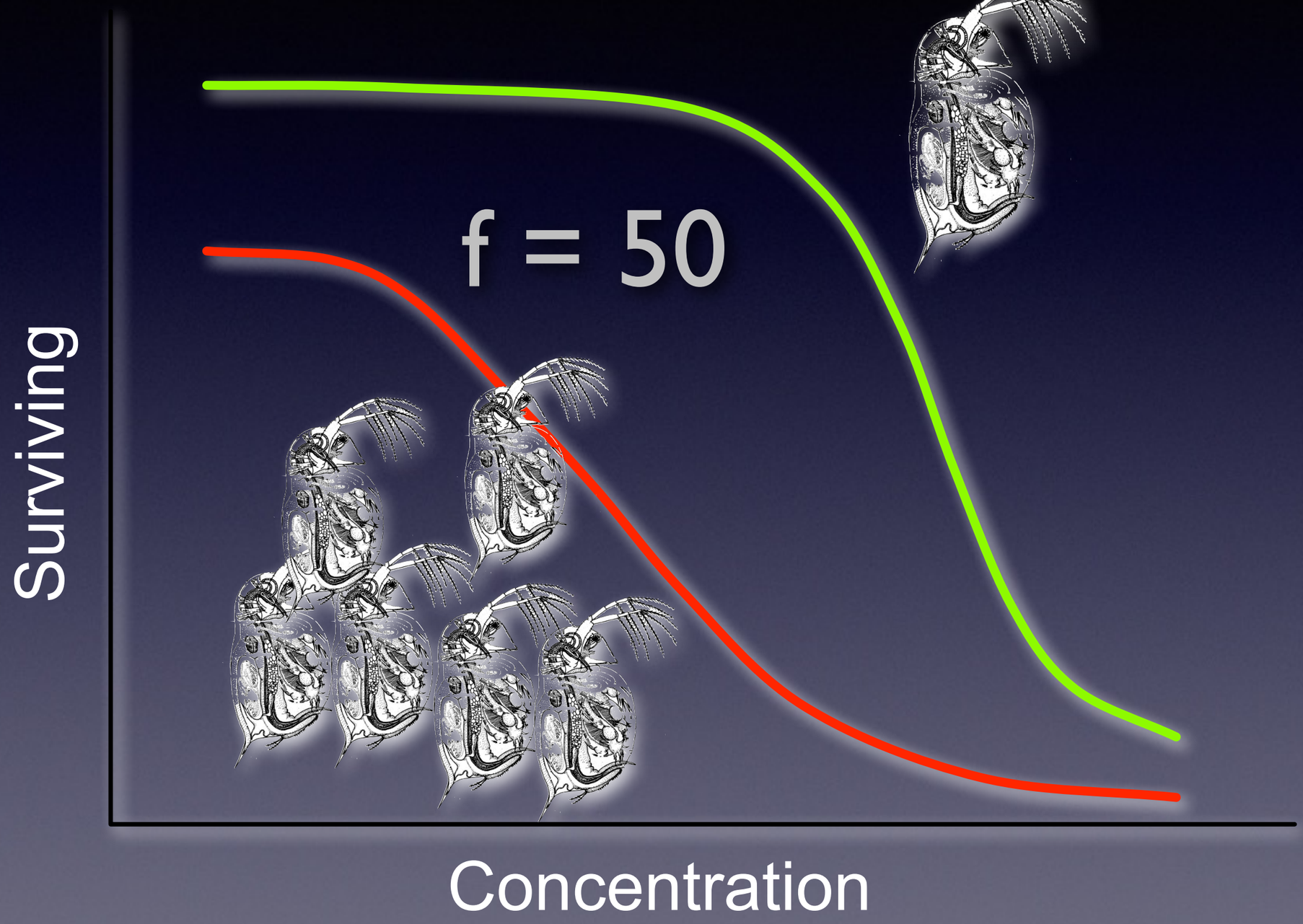


# Environmental Stress (UV)




*Liess, et al. 2001.*
*Combined effects of Ultraviolet-B radiation and food shortage on the sensitivity of the Antarctic amphipod …*
*ET&C*

# Intraspecific competition




*Knillmann, et al. 2012.*
*Intraspecific competition increases toxicant effects in outdoor microcosms.*
*Ecotoxicology*

Intraspecific Competition

Environmental Stress

Effect

Acute Stress

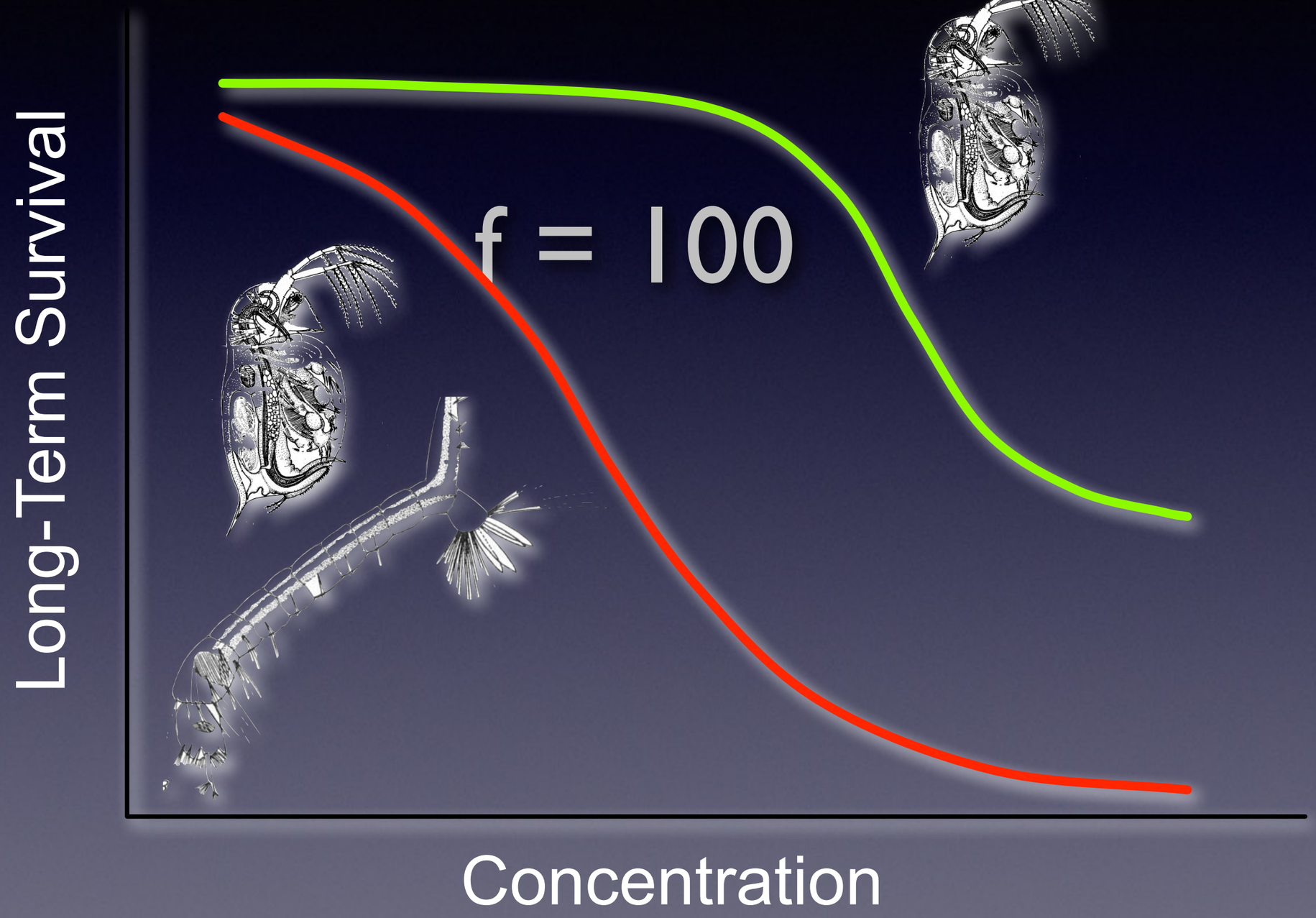
Effect

Acute
Stress

Effect

Recovery

# Interspecific Competition




*Knillmann et al. 2012.*
*Interspecific competition delays recovery of Daphnia spp. populations from pesticide stress.*
*Ecotoxicology.*

Interspecific Competition

Acute Stress

Predation

Effect

Recovery

Acute Stress

Chronic Stress

Effect

Recovery

Acute Stress

Chronic Stress

Effect

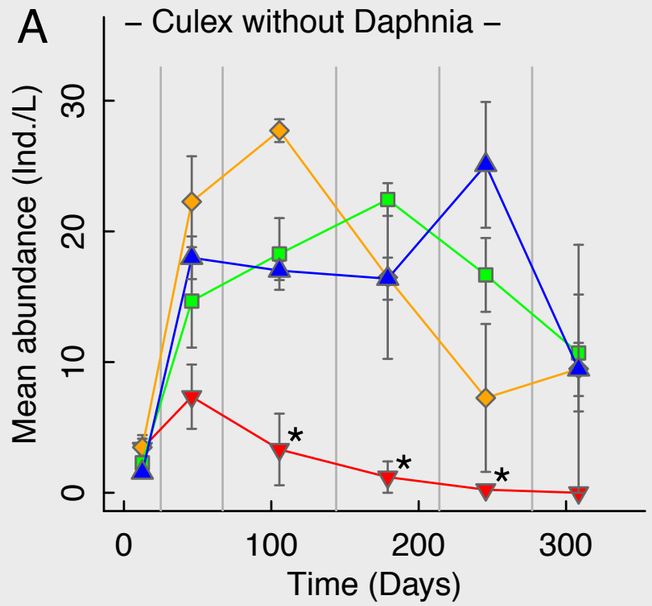
Recovery

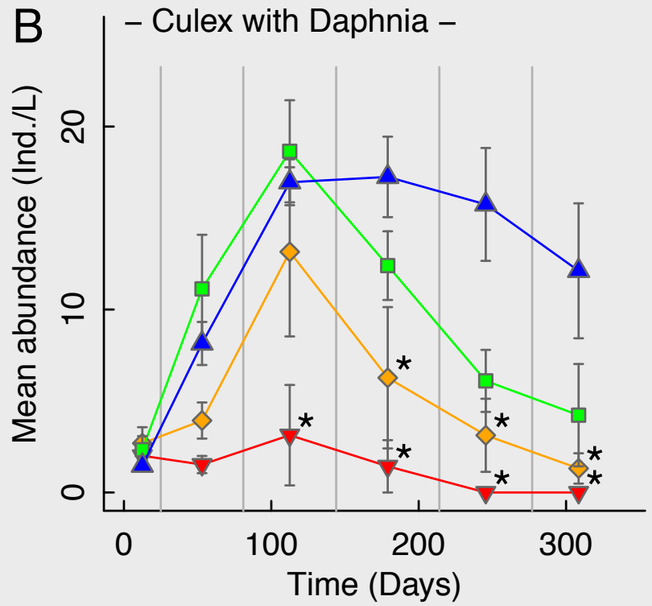
Trend

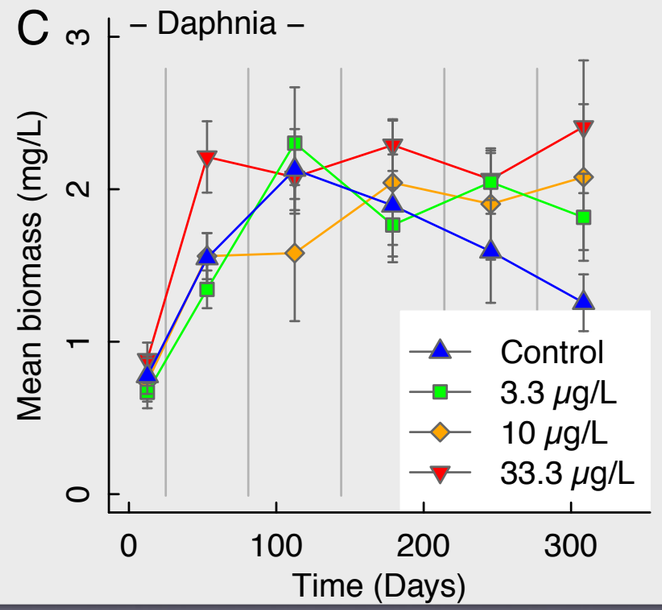
# Culmination

# f = 10






*Liess et al. 2013.*
*Culmination of low-dose pesticide effects.*
*ES&T.*

# (3) How do extrapolations (i.e. tests —> field) affect the reliability of the assessments?

Acute Stress

Chronic Stress

Culmination

(2a) Should we address multiple stressor scenarios?

- Of course

# (2b) Can we address multiple stressor scenarios?

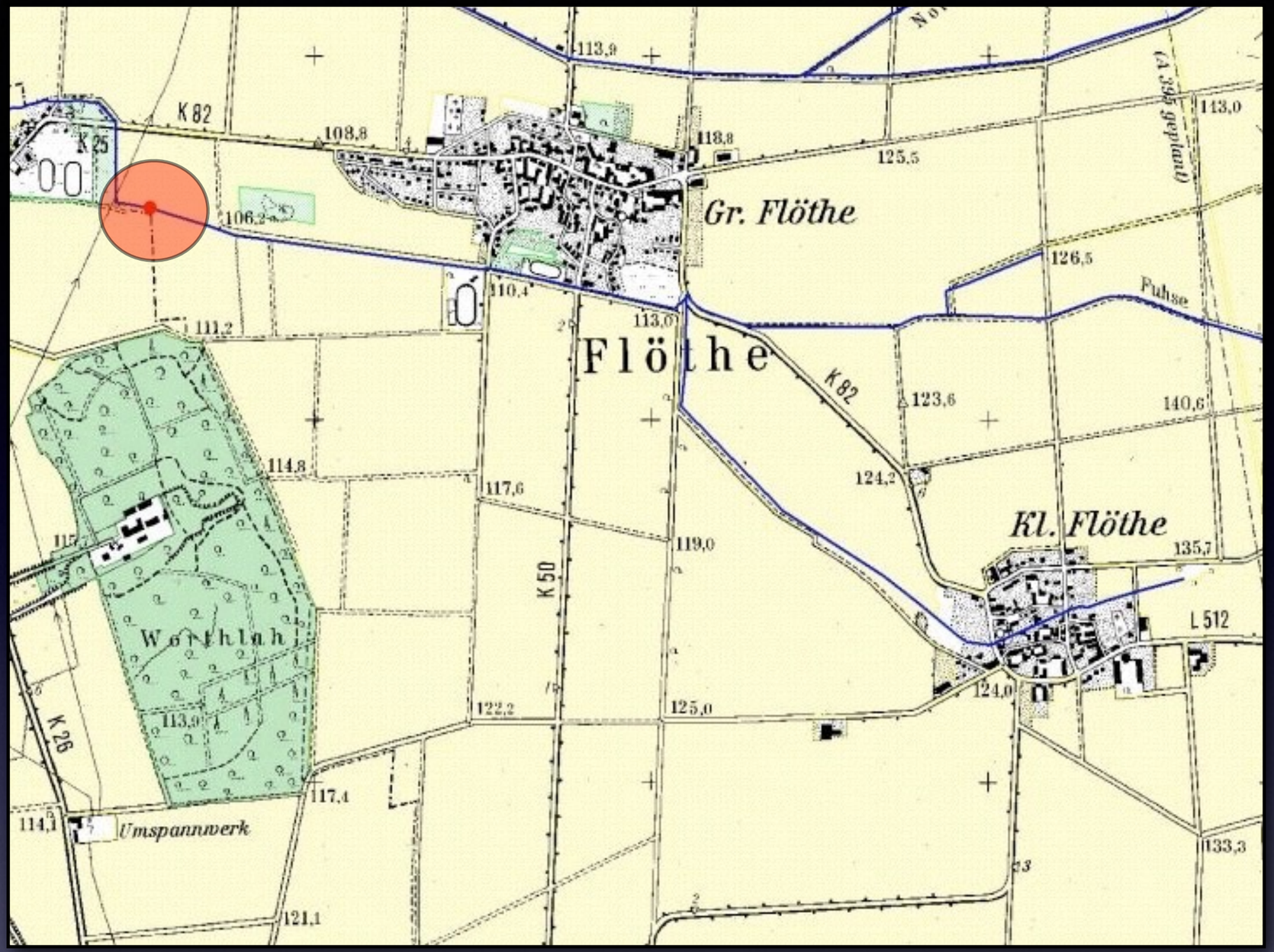
Acute Stress

Chronic Stress

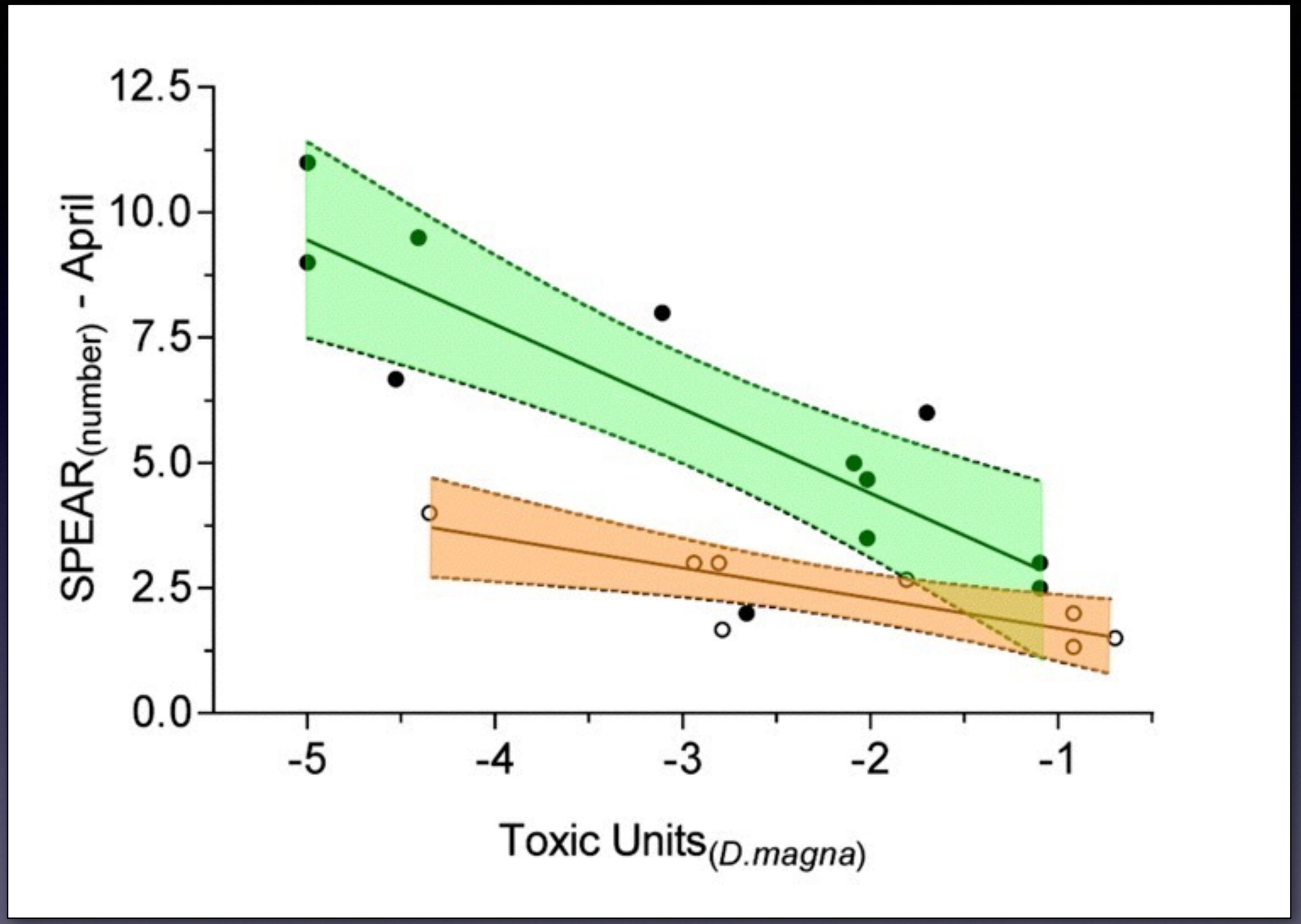
Culmination

Effect → Recovery → Trend

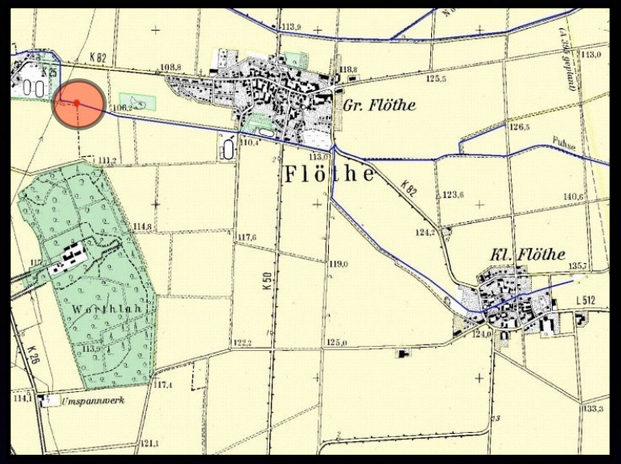
# (4) Do we need to protect all waters?

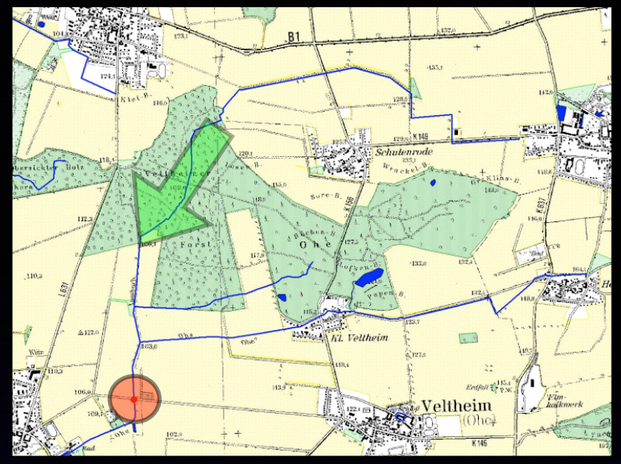

K 82
K 25
108,8
106,2
113,9
118,8
125,5
113,0
Gr. Flöthe
126,5
Fluhse
110,4
111,2
113,0
Flöthe
K 82
123,6
140,6
114,8
117,6
124,2
Kl. Flöthe
135,7
119,0
K 50
L 512
Wethlah
124,0
122,2
125,0
113,9
K 26
117,4
114,1
Umspannwerk
133,3
121,1

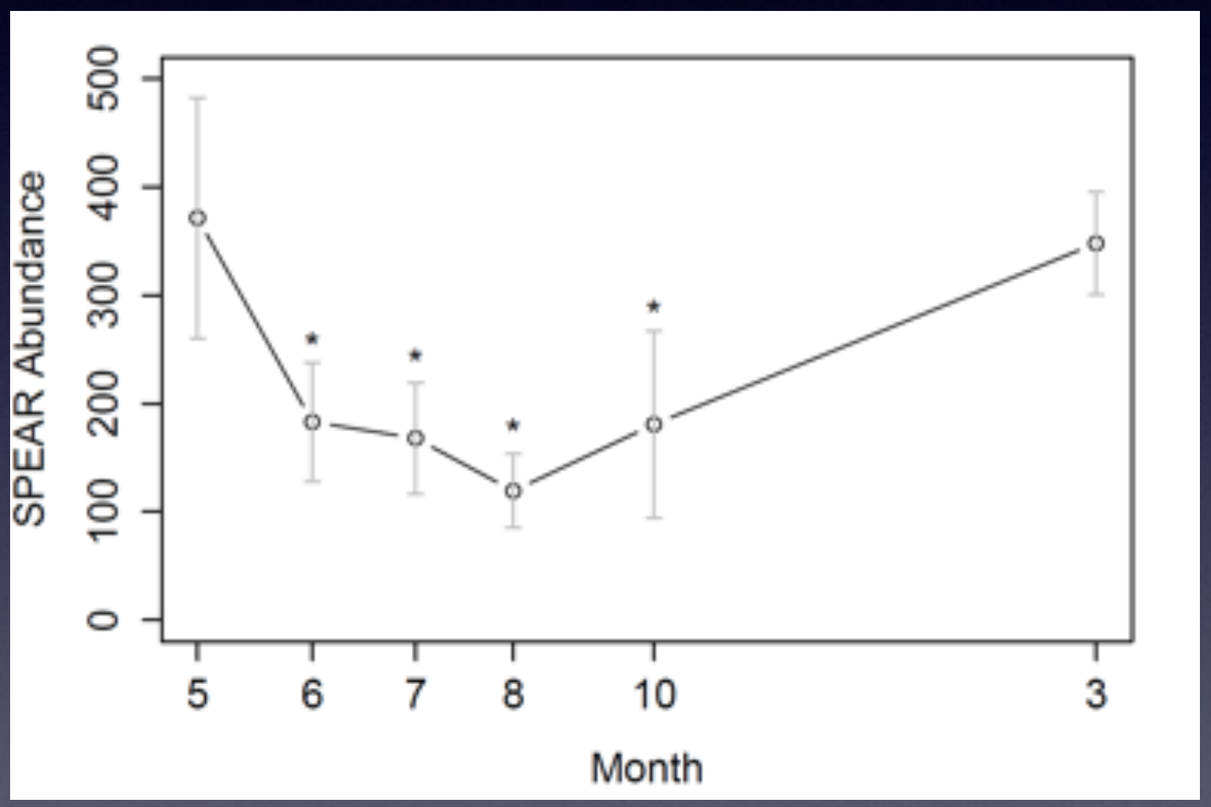
Flöthe
Gr. Flöthe
Kl. Flöthe
Wrthlah
Umspannwerk
K 82
K 25
K 50
K 26
L 512
Fluhse
Schulenrode
K 148
Kl. Veltheim
Veltheim
(Ohe)
K 146
L 631
K 156
K 637
Ohe

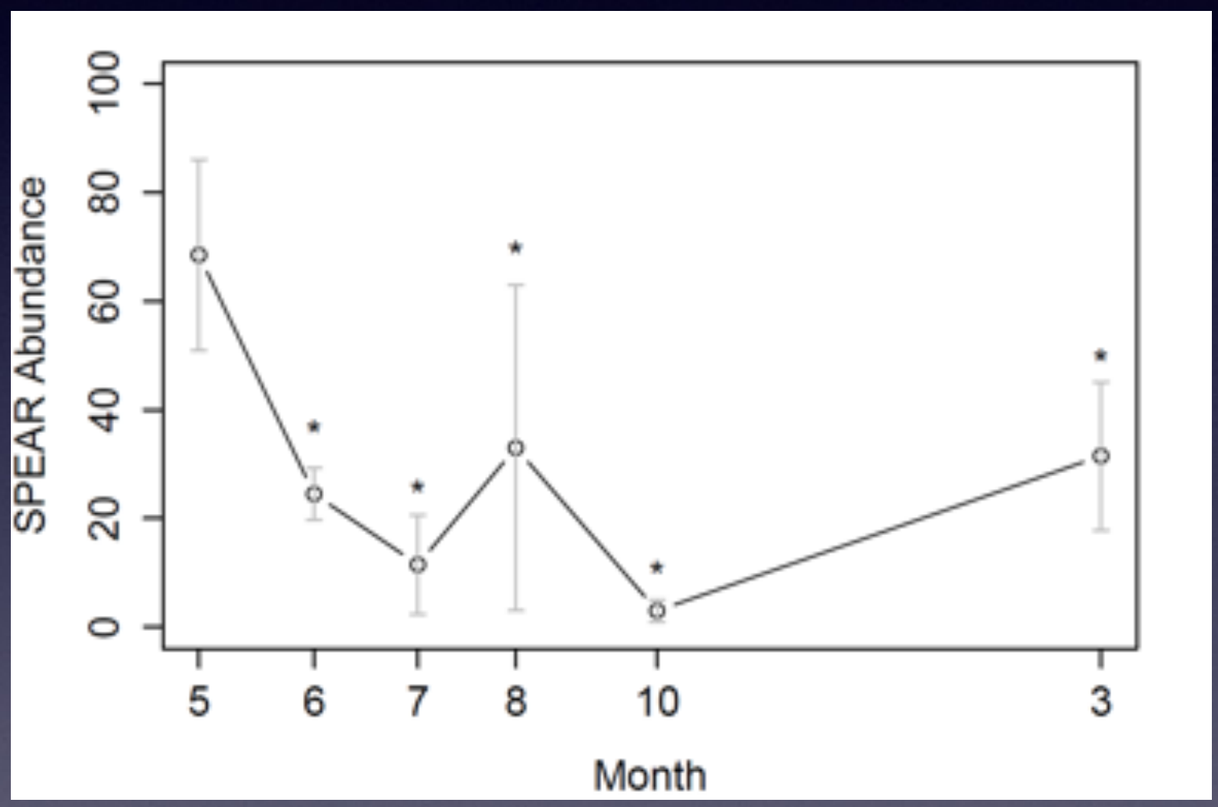



*Liess M et al. 2005.*
*Analyzing effects of pesticides on invertebrate communities in streams.*
*ET&C*



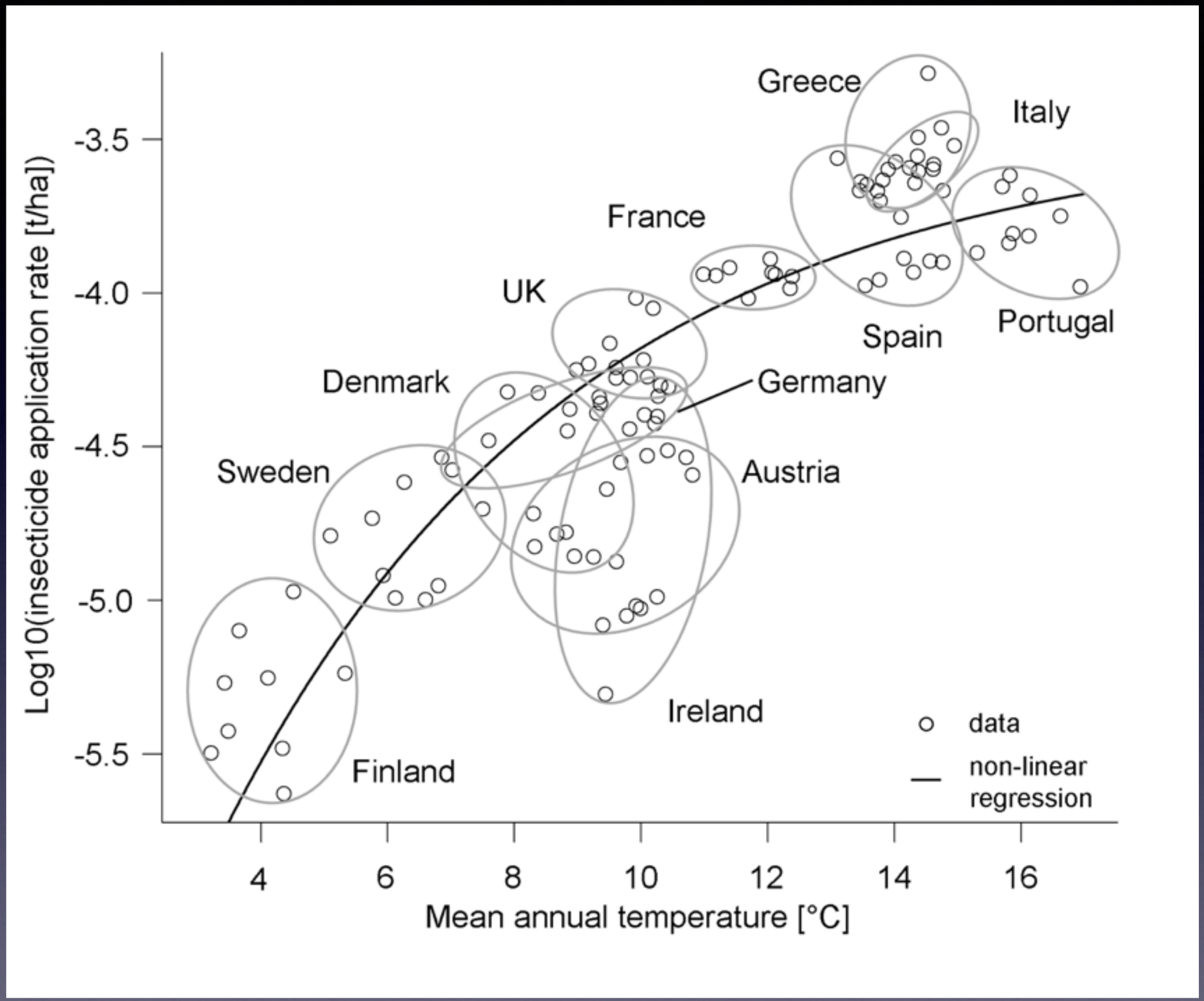

*Khrycheva et al. in prep.*

(5) Do we have faith that the current registration process protects aquatic organisms and ecosystem processes?

- Extrapolation does not include environmental context
  - No stress
  - No culmination
- Higher-Tier systems do not resemble real ecosystems
  - Few vulnerable species
  - No culmination

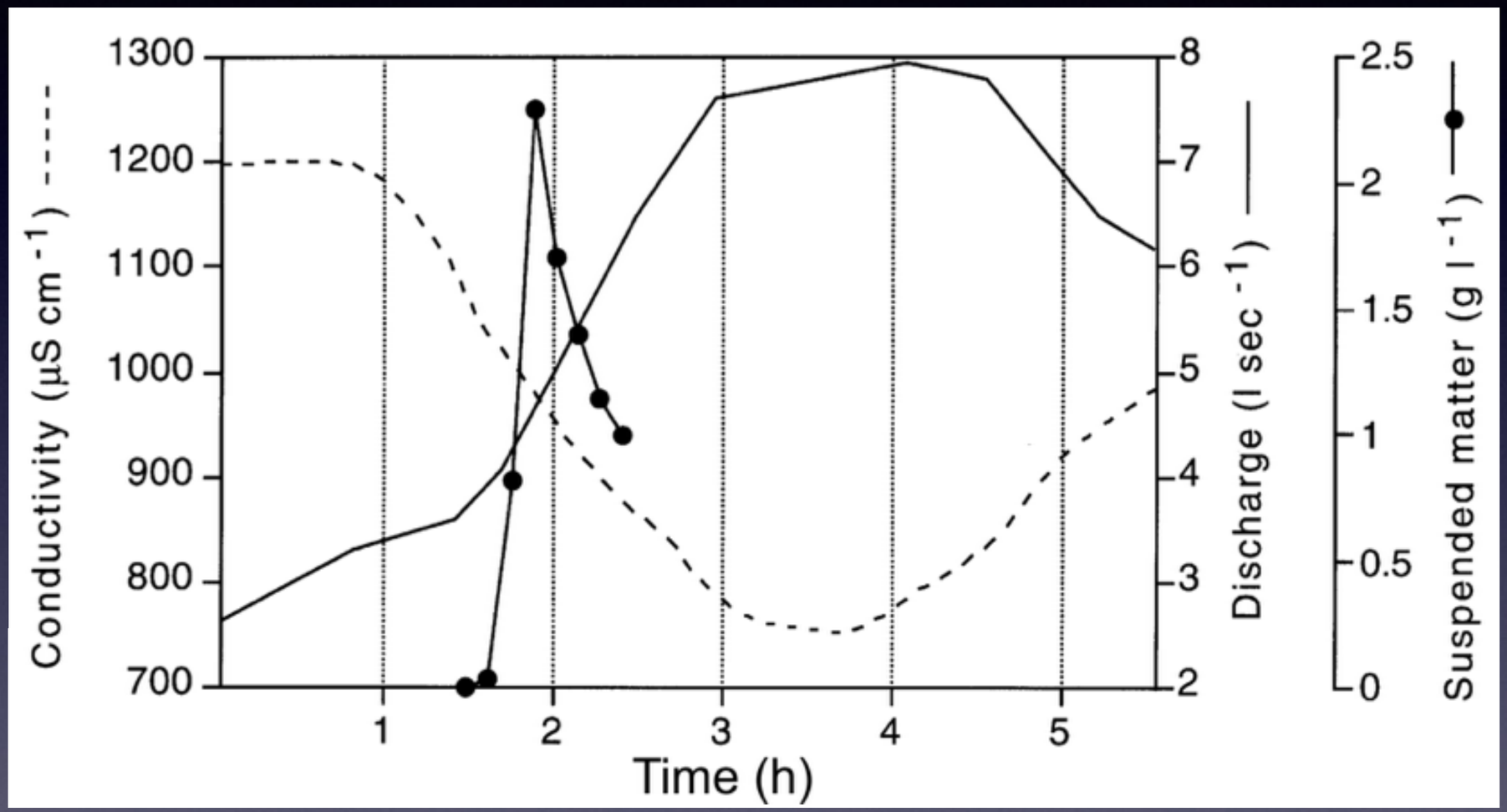
- Simulation models reproduce flaws made in test - systems
  - No stress
  - No culmination

(6) How can we improve on current monitoring efforts?



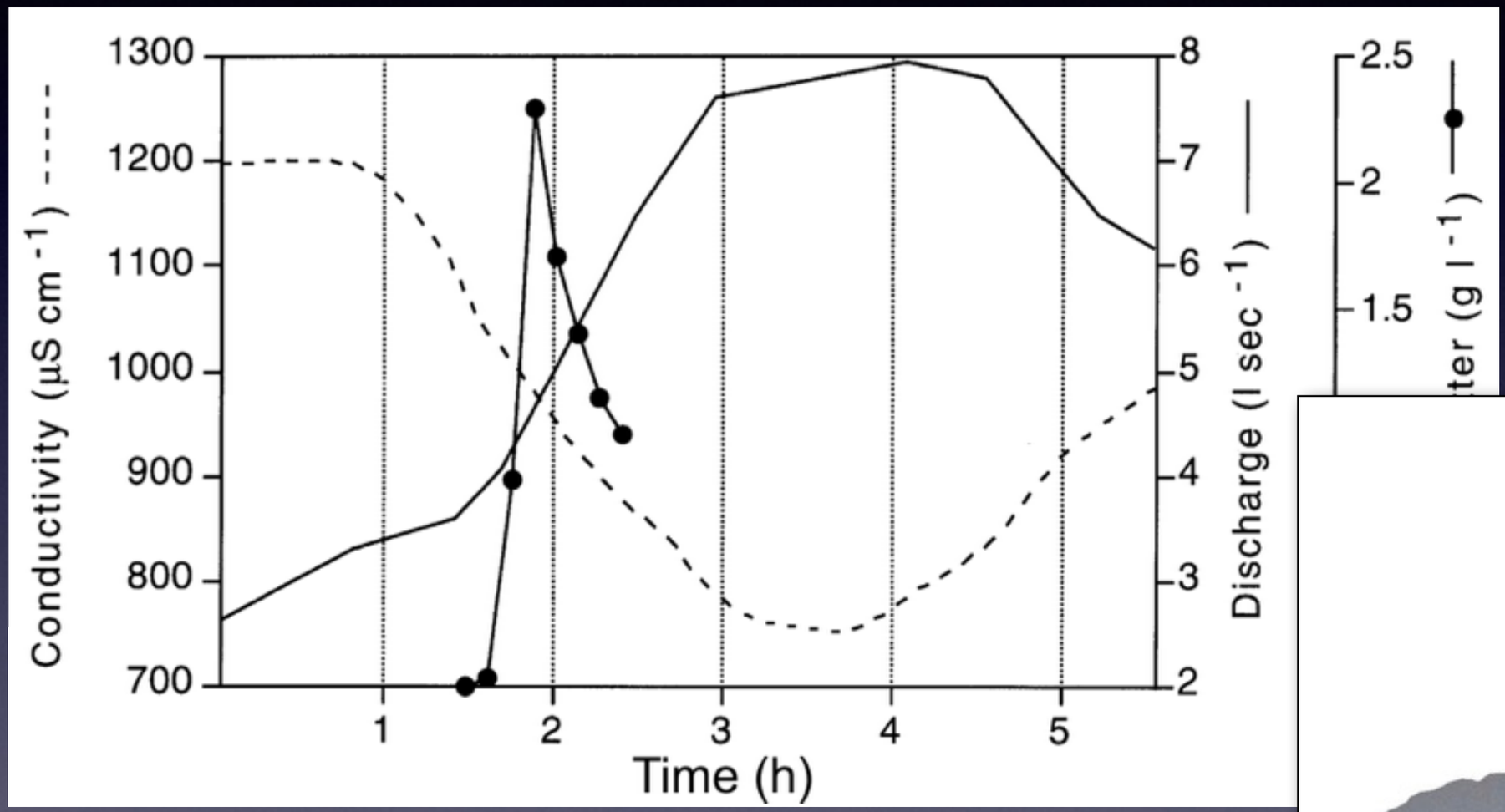

*Kattwinkel et al. 201. Ecological applications.*

# Exposure:




*Liess et al. 1999. Water Research*

# Exposure:





*Liess et al. 1999. Water Research*

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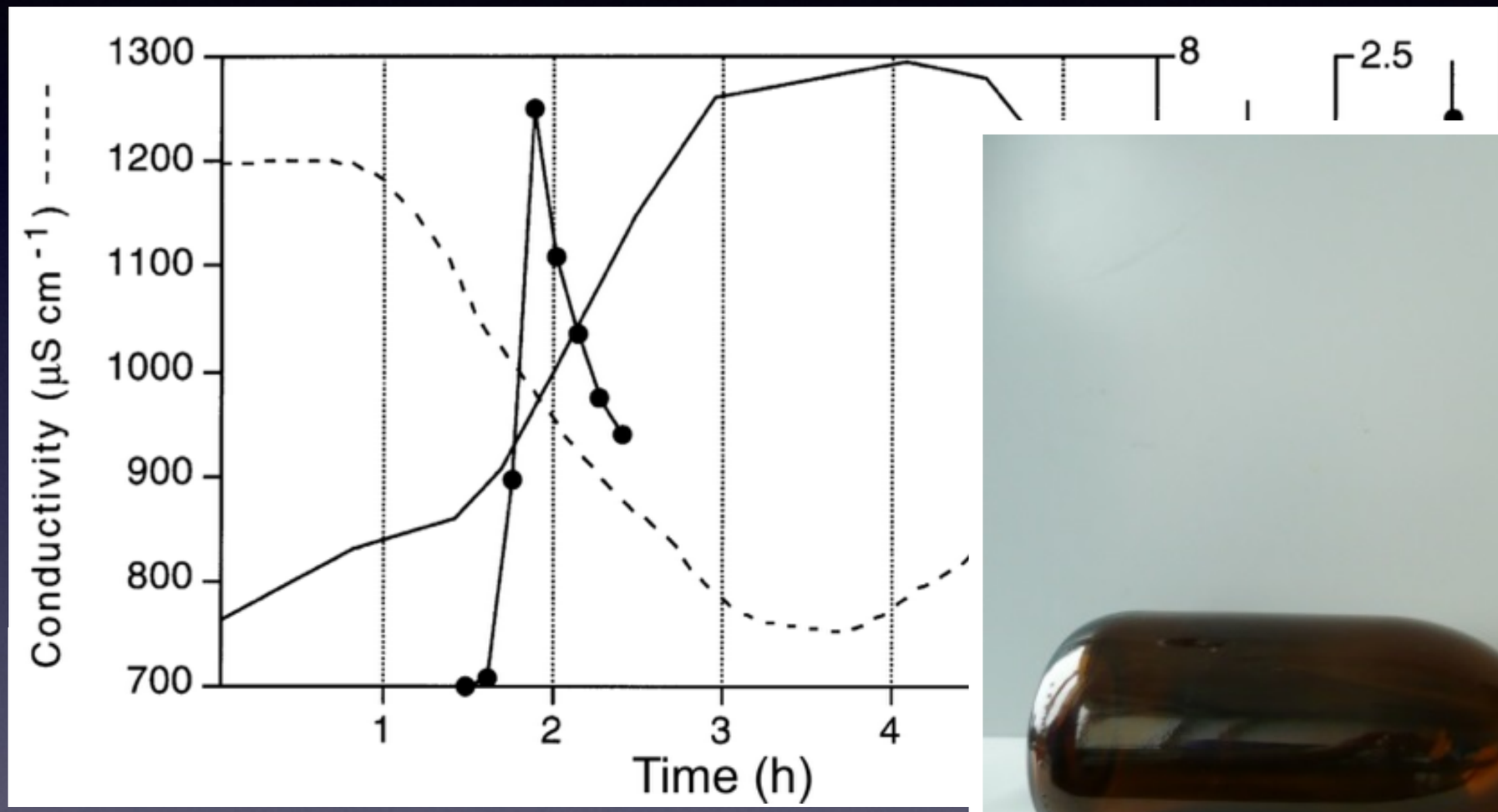
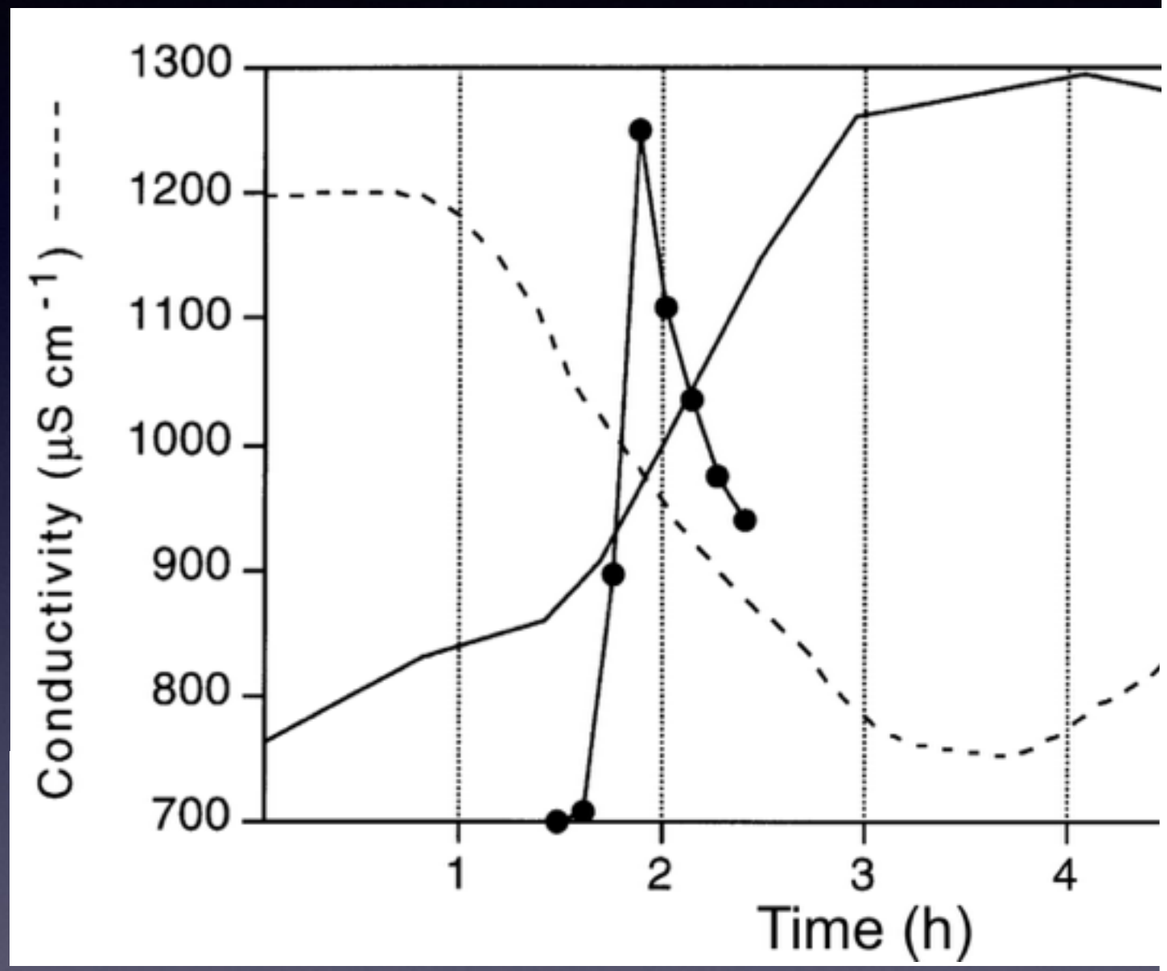



*Liess et al. 1999. Water Research*

*Liess et al. 2005. ET&C*

# Exposure:




*Liess et al. 1999. Water Research*

*Schäfer et al. 2007. STOTEN*

*Liess et al. 2005. ET&C*

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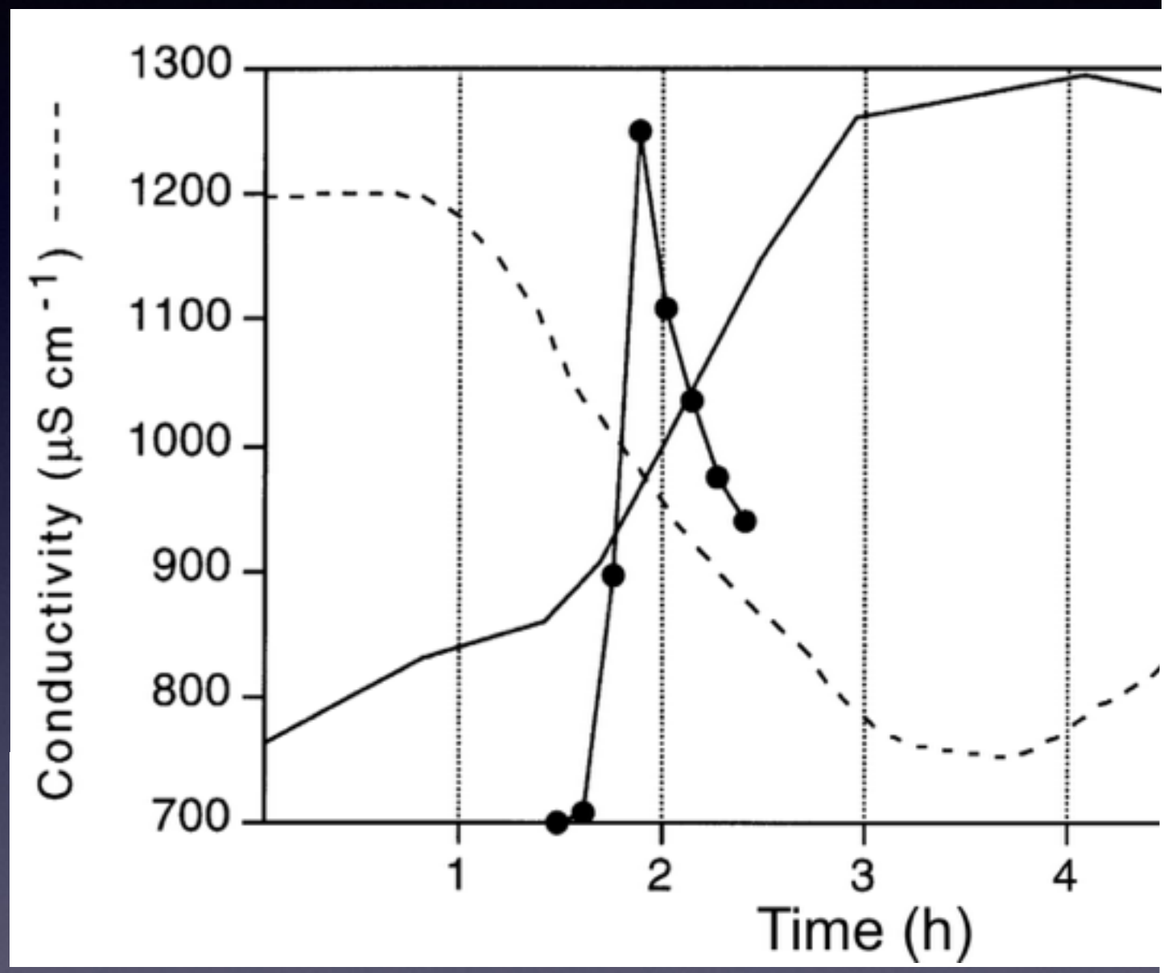
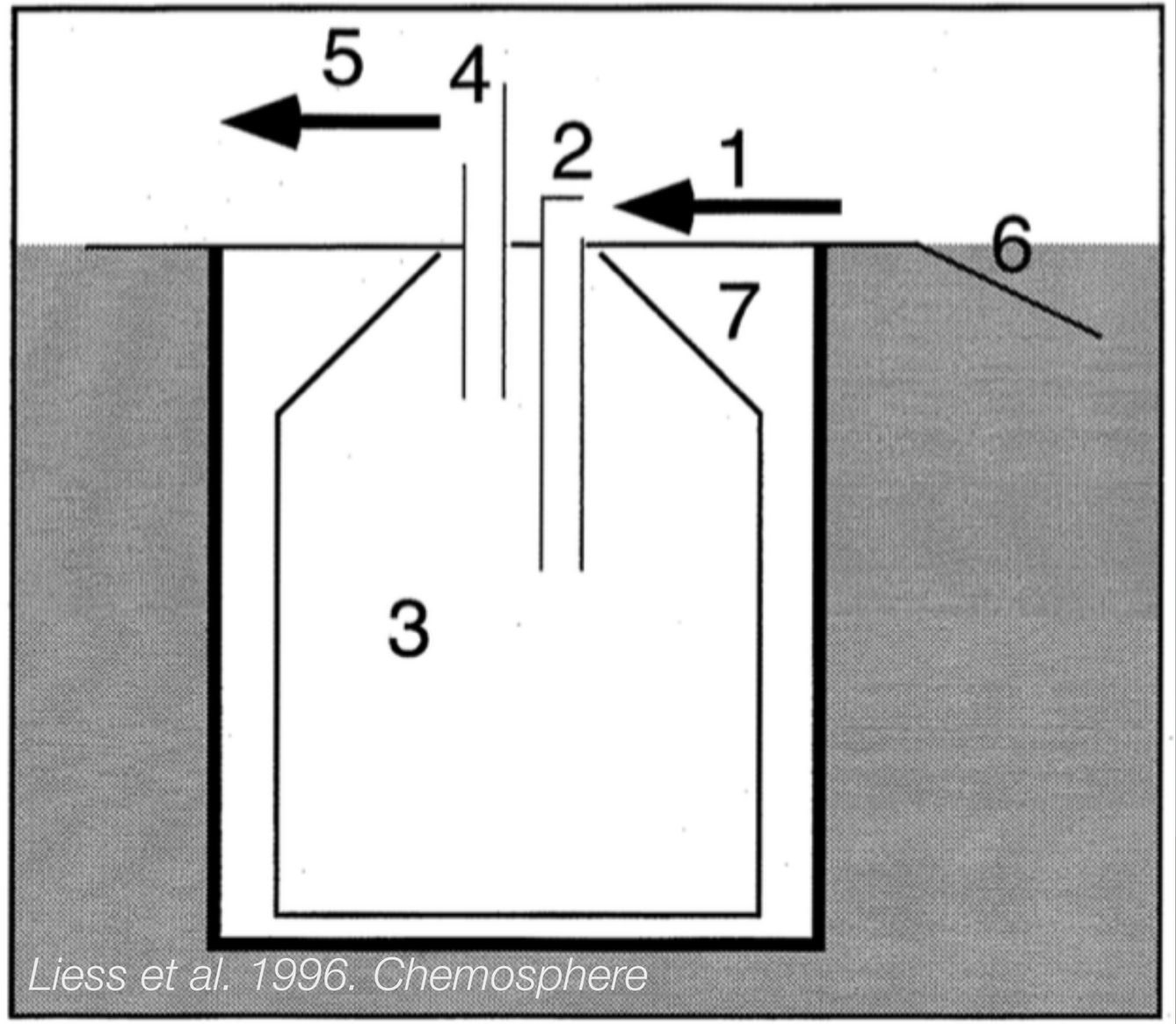



Liess et al. 1999. Water Research




Liess et al. 1996. Chemosphere

Schäfer et al. 2007. STOTEN

Liess et al. 2005. ET&C

# Effect:

- Monitorung invertebrates during, shortly after exposure
- June invertebrates
- Plants?

# Summary & Outlook

Acute Stress

Chronic Stress

Culmination

Effect

Recovery

Trend

Effect-translation
(Lab acute - Field chronic)

Effect-translation
(Lab acute - Field chronic)

- Acute / Chronic: f = 10

Effect-translation
(Lab acute - Field chronic)

- Acute / Chronic: f = 10
- Stress: f = 10

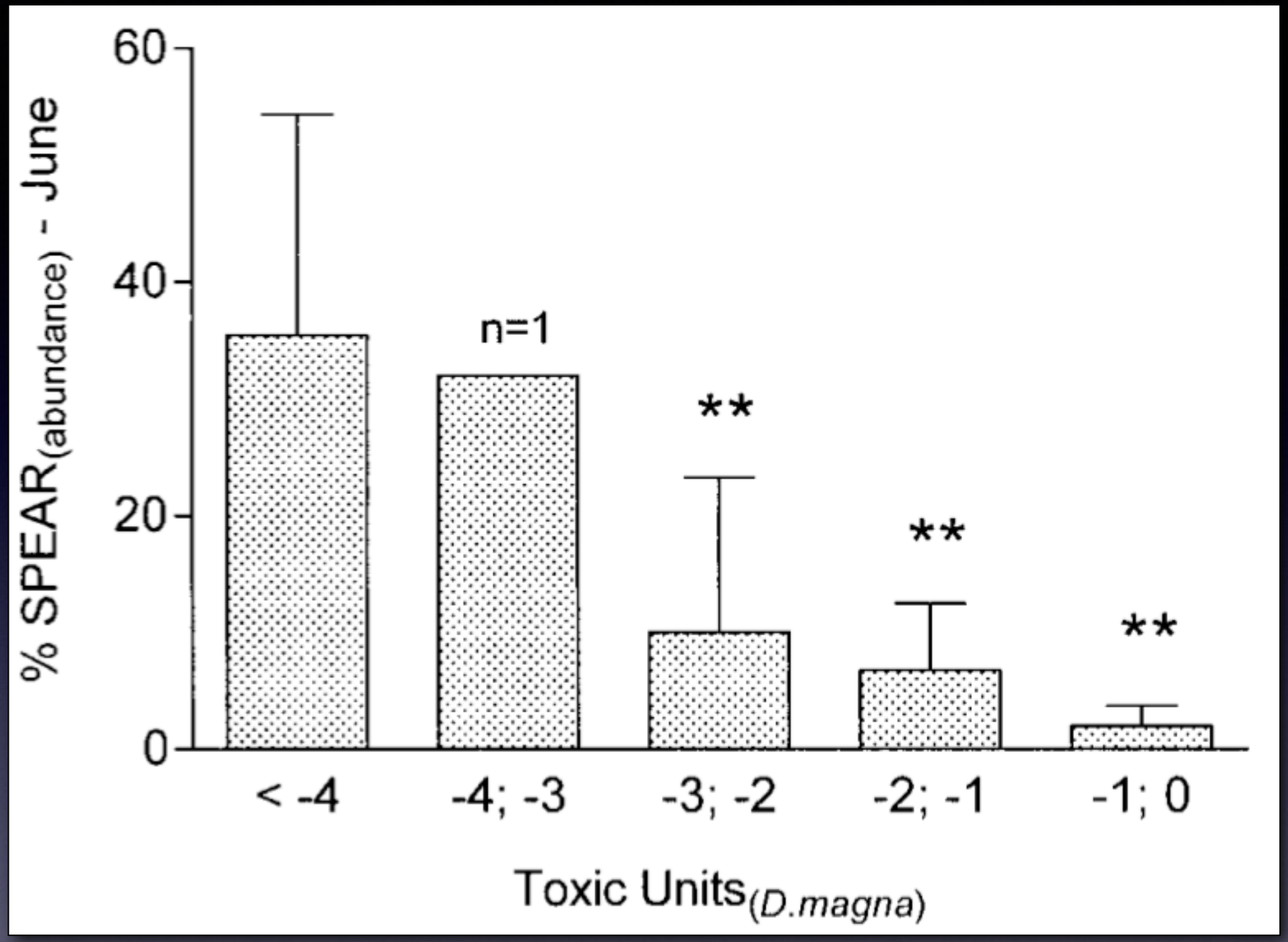
Effect-translation
(Lab acute - Field chronic)

- Acute / Chronic: f = 10
- Stress: f = 10
- Culmination: f = 10

Effect-translation
(Lab acute - Field chronic)

- Acute / Chronic: f = 10
- Stress: f = 10
- Culmination: f = 10

Total f = 1000

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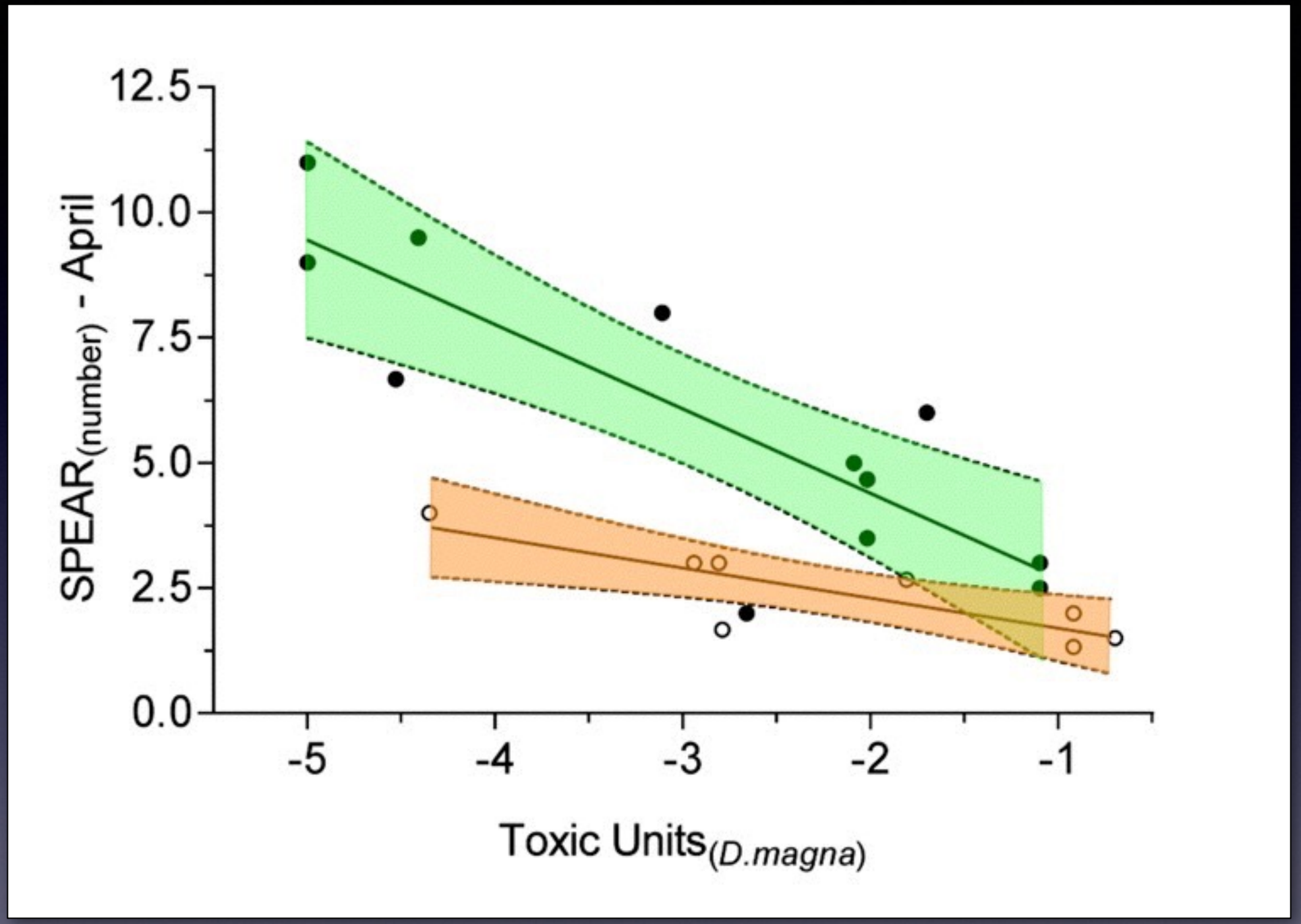
***Schäfer et al.*** *2012. ES&T*
***Bunzel K, et al.*** *2013. Water Research*
***Rasmussen et al.*** *2013. STOTEN*
***Smetanováa S, et al.*** *2014. Environmental Pollution*

Effect-translation
(Lab acute - Field chronic)

- Acute / Chronic: f = 10
- Stress: f = 10
- Culmination: f = 10
- Recolonization: f = 10

Total f = 100




*Liess M et al. 2005.*
*Analyzing effects of pesticides on invertebrate communities in streams.*
*ET&C*

Ecological Risk-Assessment

needs combining approaches

Prospective
&
Retrospective