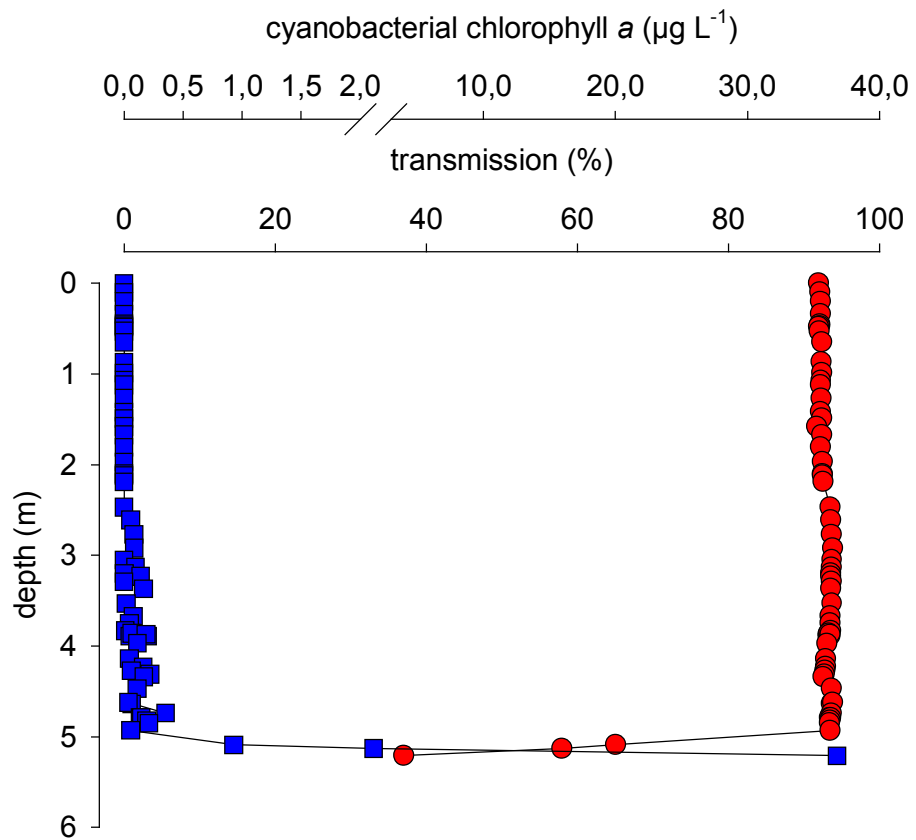




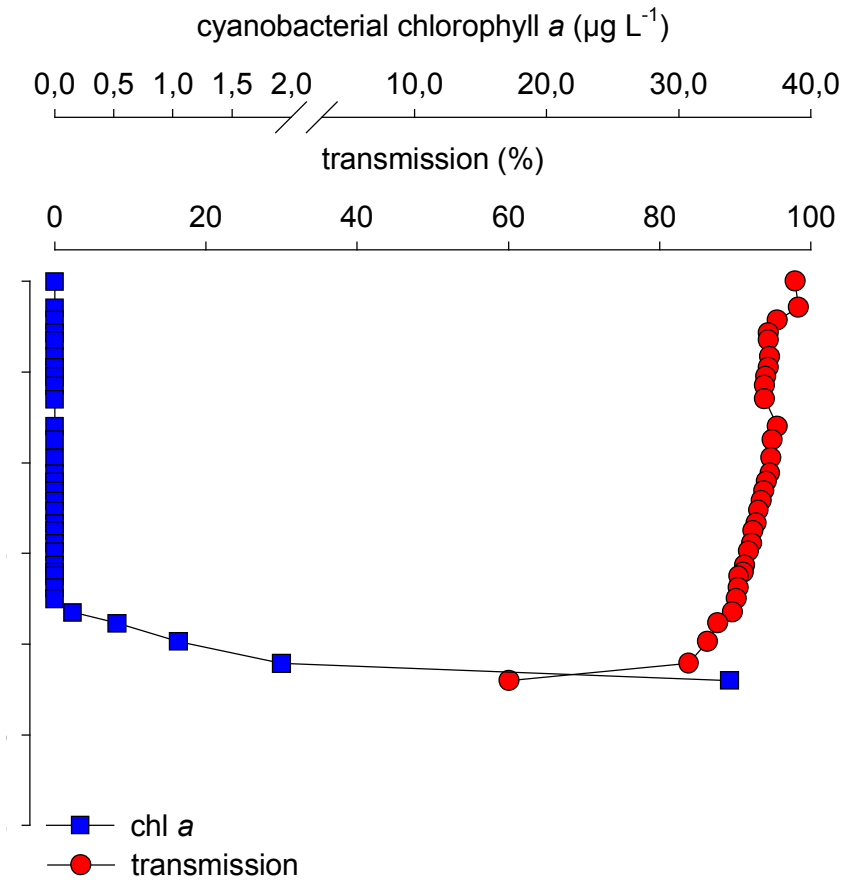
PROLOGUE:

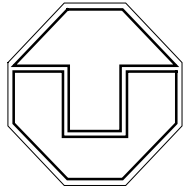
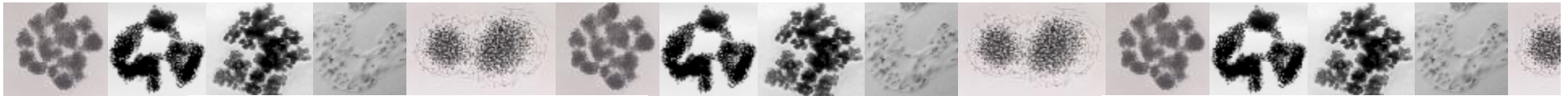
...a mysterious phenomenon ?

03/04/2001



09/01/2002



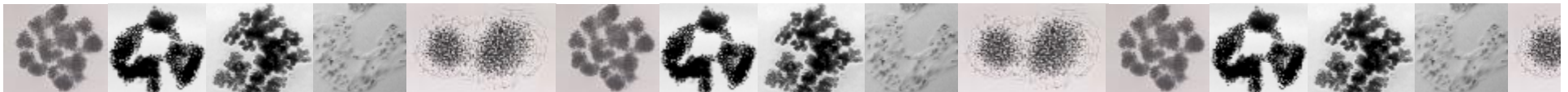


TECHNISCHE
UNIVERSITÄT
DRESDEN

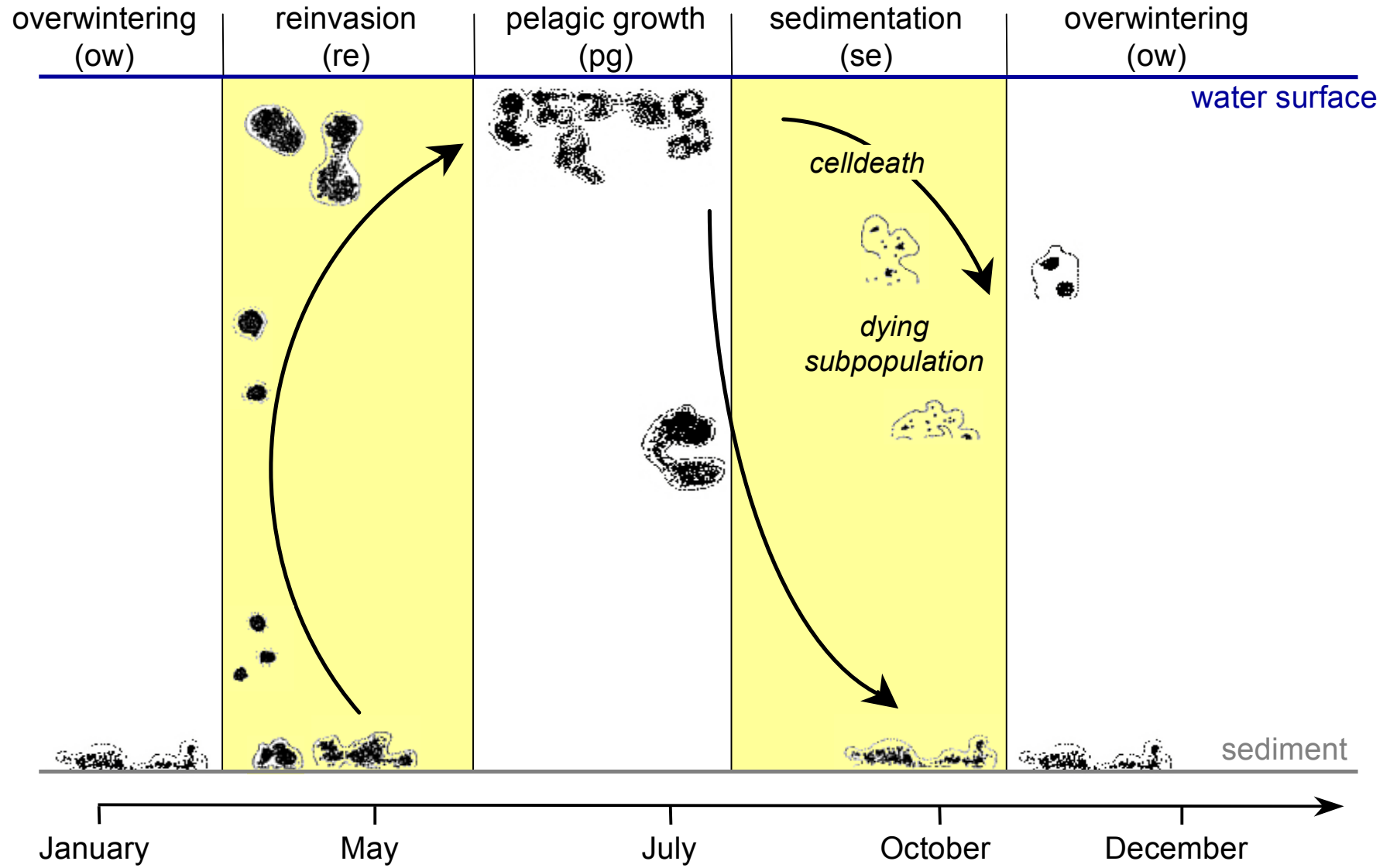
Wax and Wane of *Microcystis* in Lake Sediments

Tilo Ihle & Sabine Jähnichen

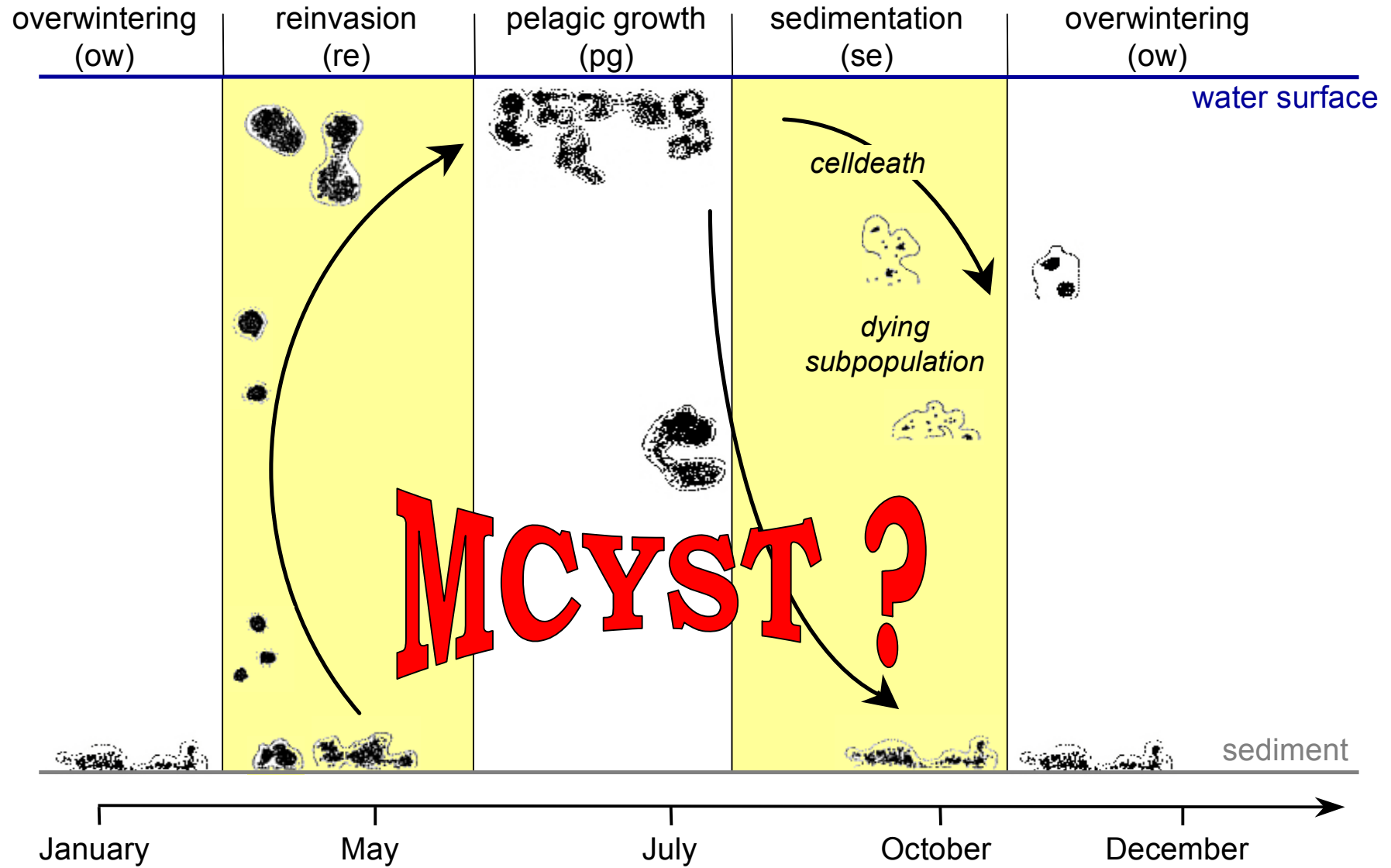
Institute for Hydrobiology



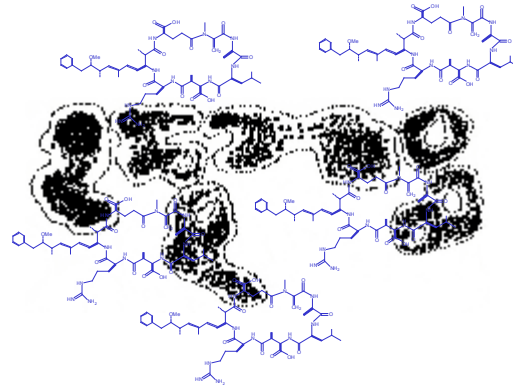
Annual Lifecycle of *Microcystis*



Annual Lifecycle of *Microcystis*



Ecological Function(s) of MCYST ?



putative intracellular function

putative extracellular function

only secondary metabolit
or
ecophysiological function

allelopathy, chemical
communication

feeding deterrence



primary function

growth and/or
metabolism of the
producer

≠

secondary effects

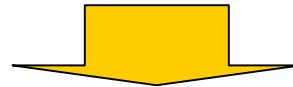
(ecological relevance)

WHAT ?

spatio-temporal distribution \Rightarrow ecological significance of MCYST ?

HOW ?

phenology of cyanobacteria + phenology of MCYST

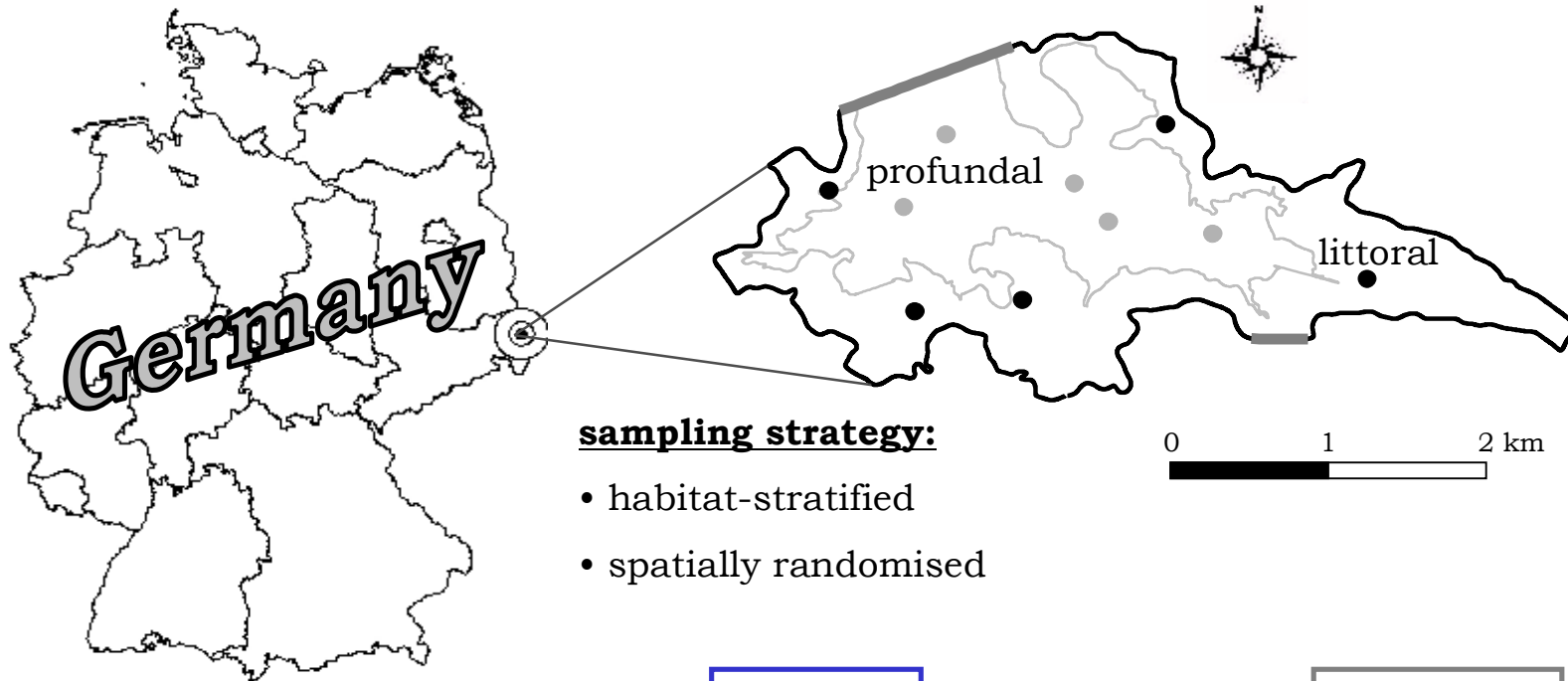


MCYST - mass balance

WHEREBY ?

spatio-temporal coverage of cyanobacteria & MCYST

Methodology: field investigations in Quitzdorf Reservoir



sampling strategy:

- habitat-stratified
- spatially randomised

pelagic

sediment

cyanobacteria

biovolume

biovolume

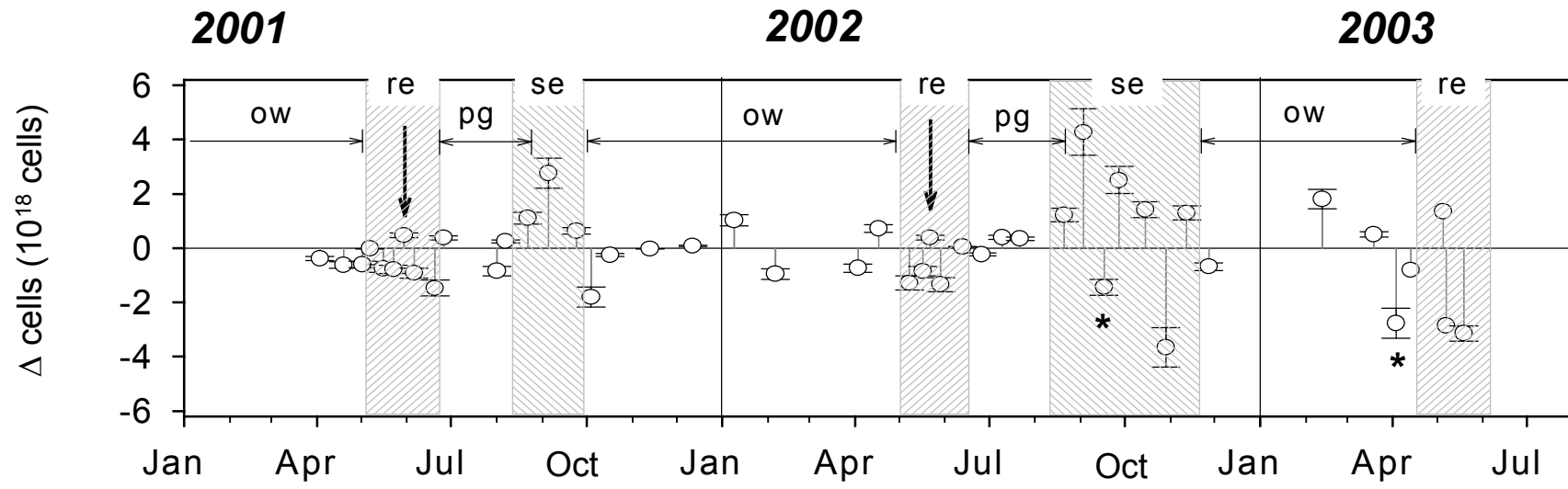
vertical/horizontal distribution
(bbe multichannel fluorescence probe)

**MCYST - analysis
(HPLC)**

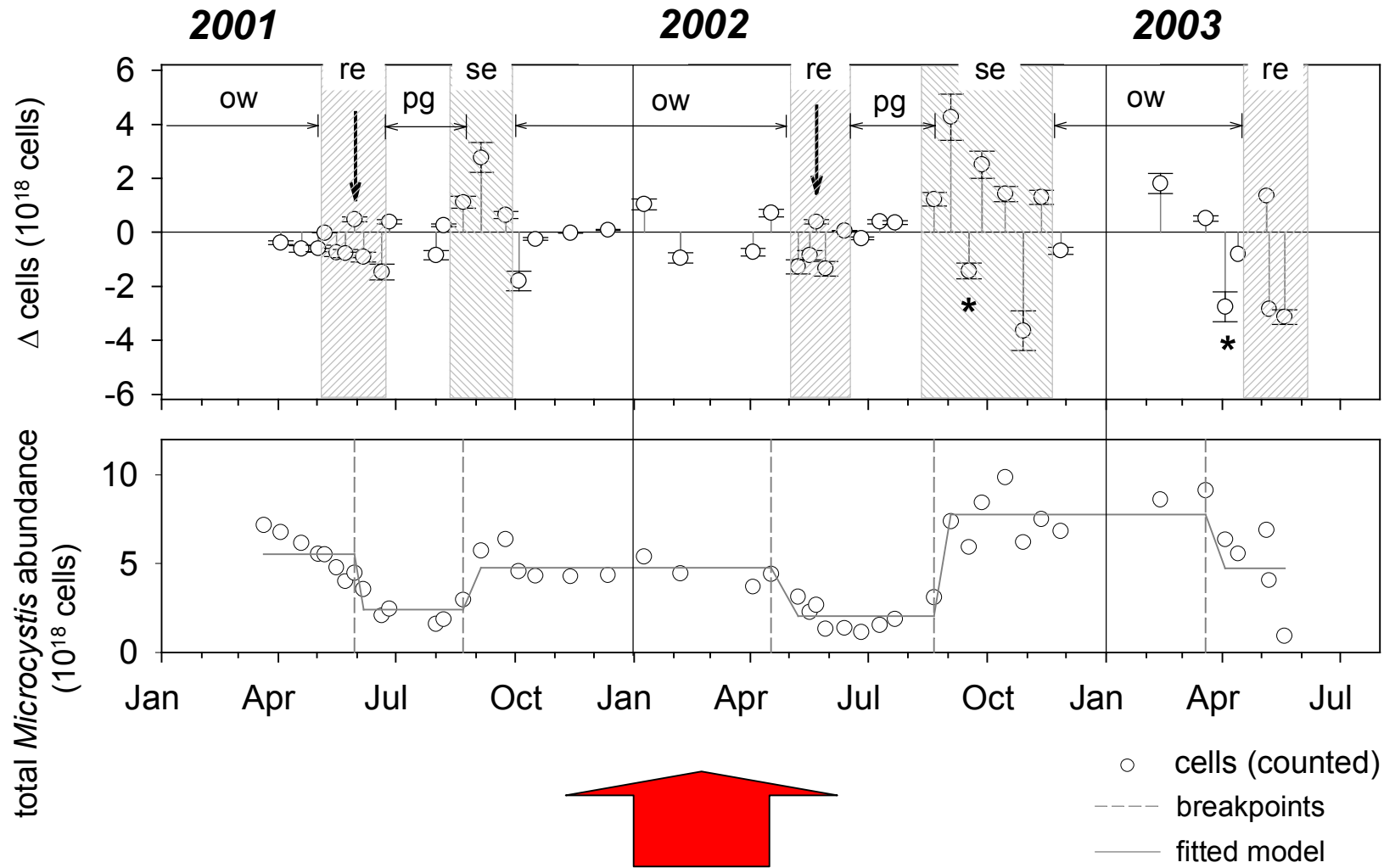
MCYST_{intra-/extracellular}

MCYST_{intracellular}

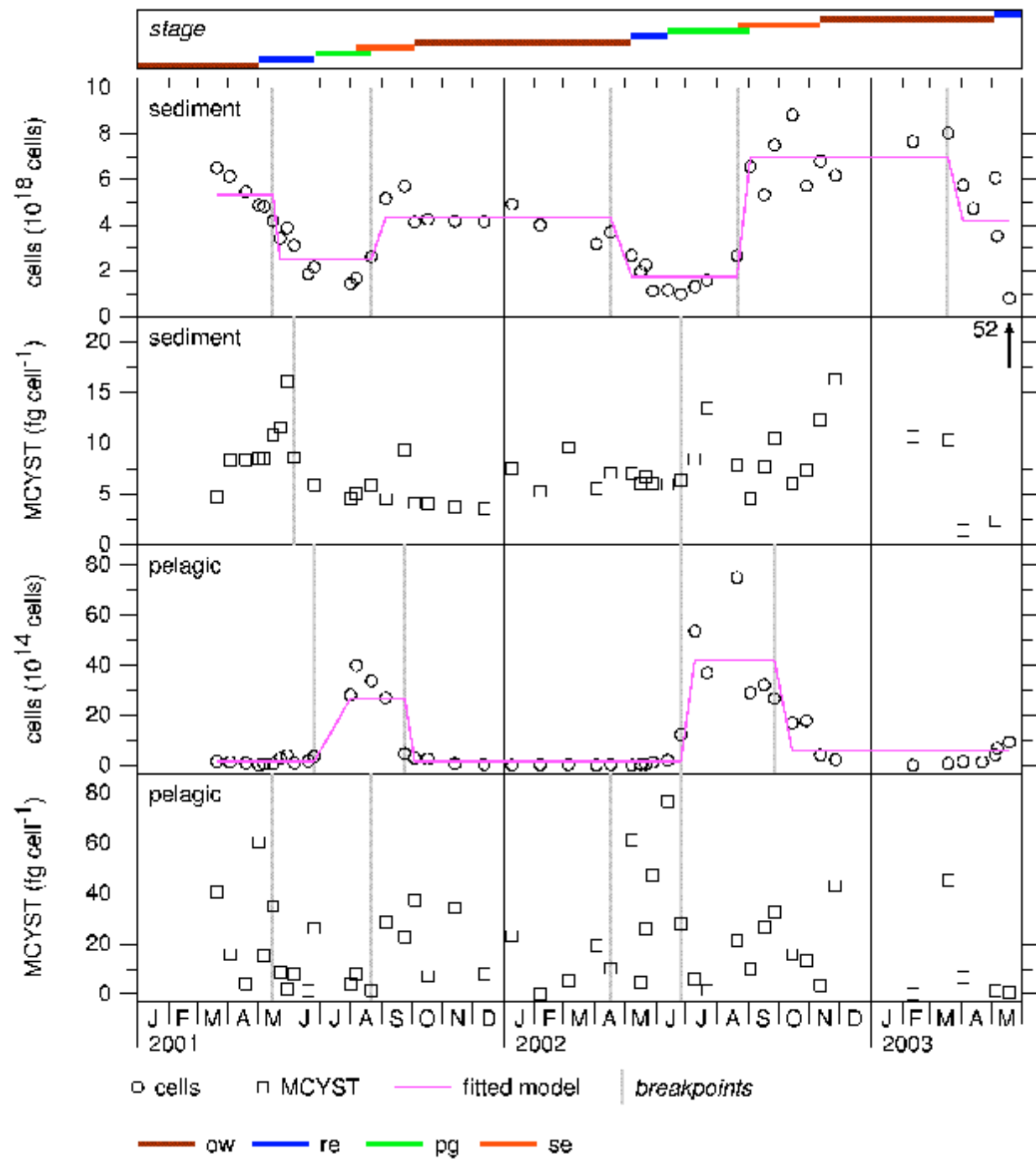
Identification of phenological phases



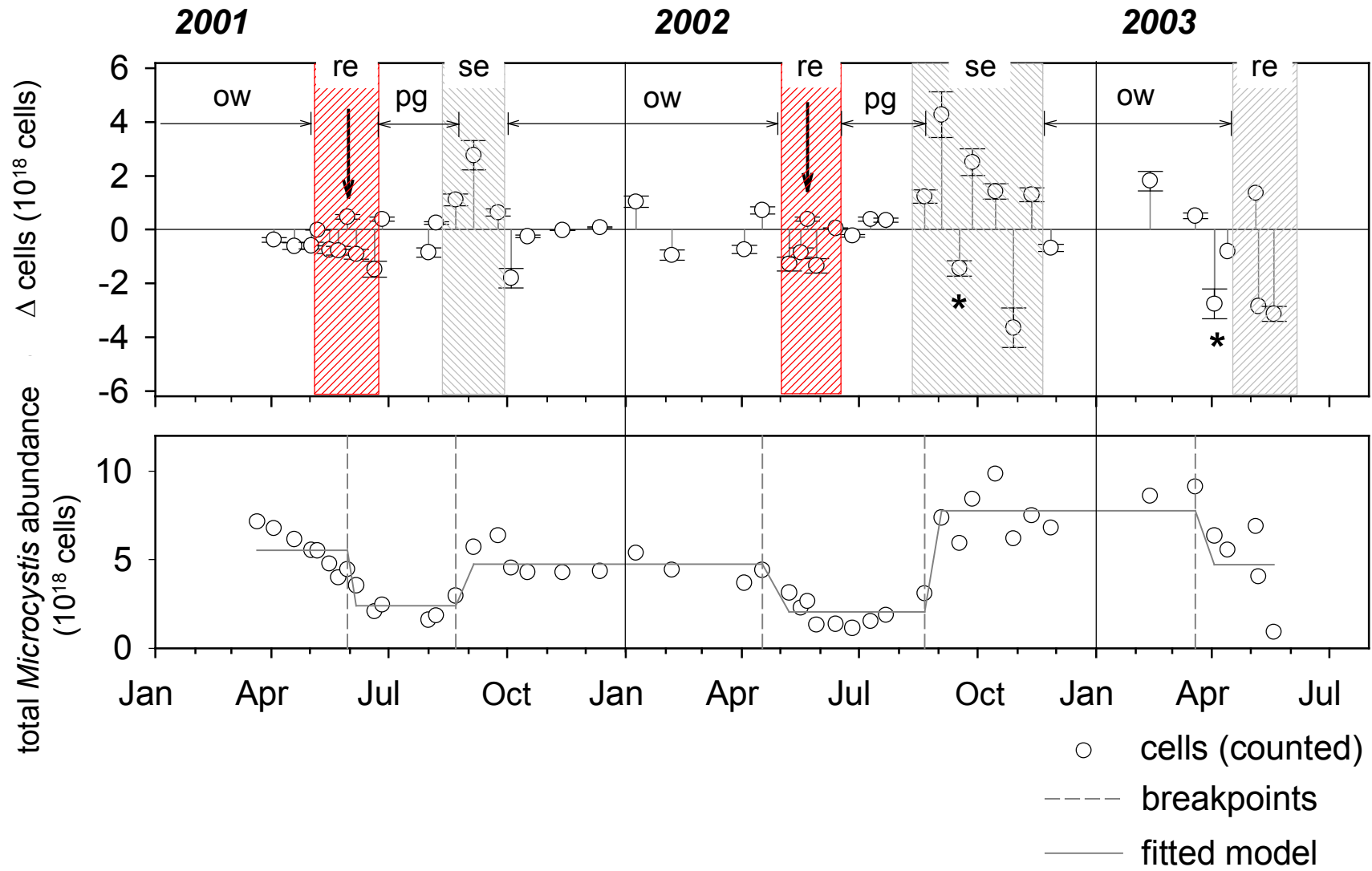
Identification of phenological phases



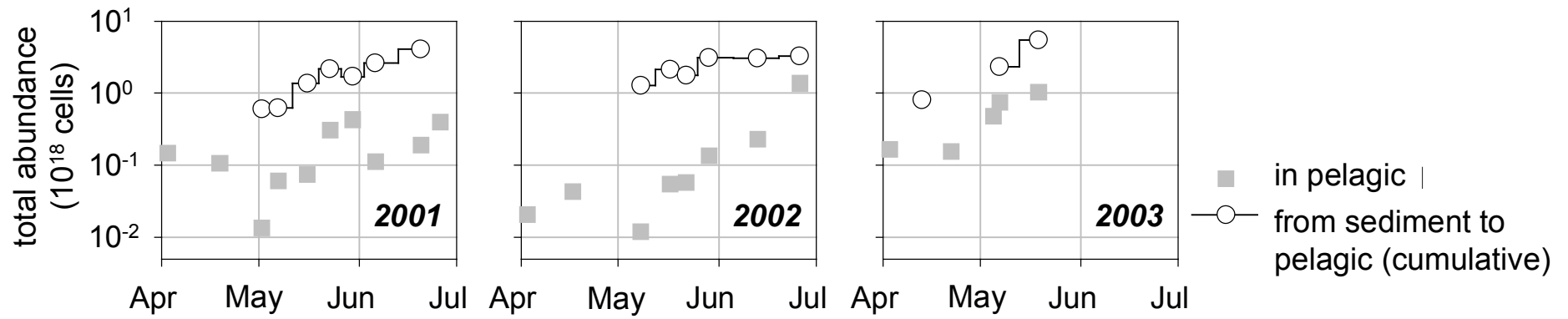
breakpoint analysis



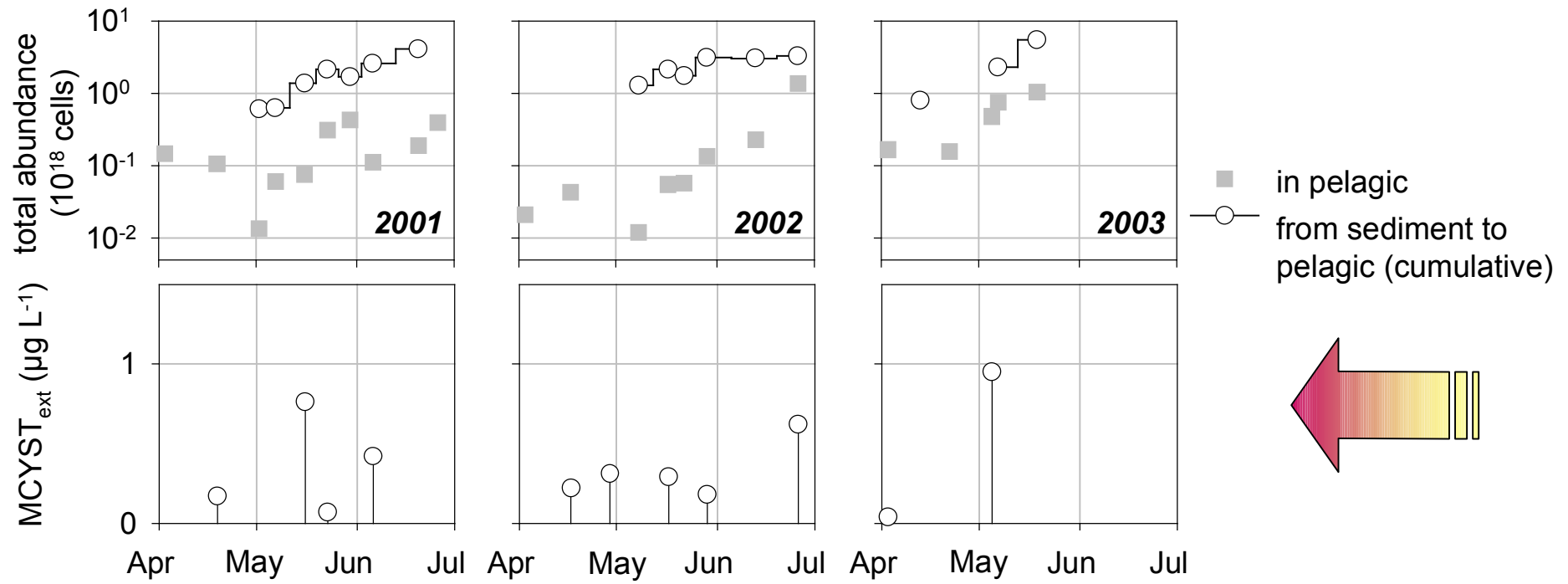
Phenological phases: reinvasion



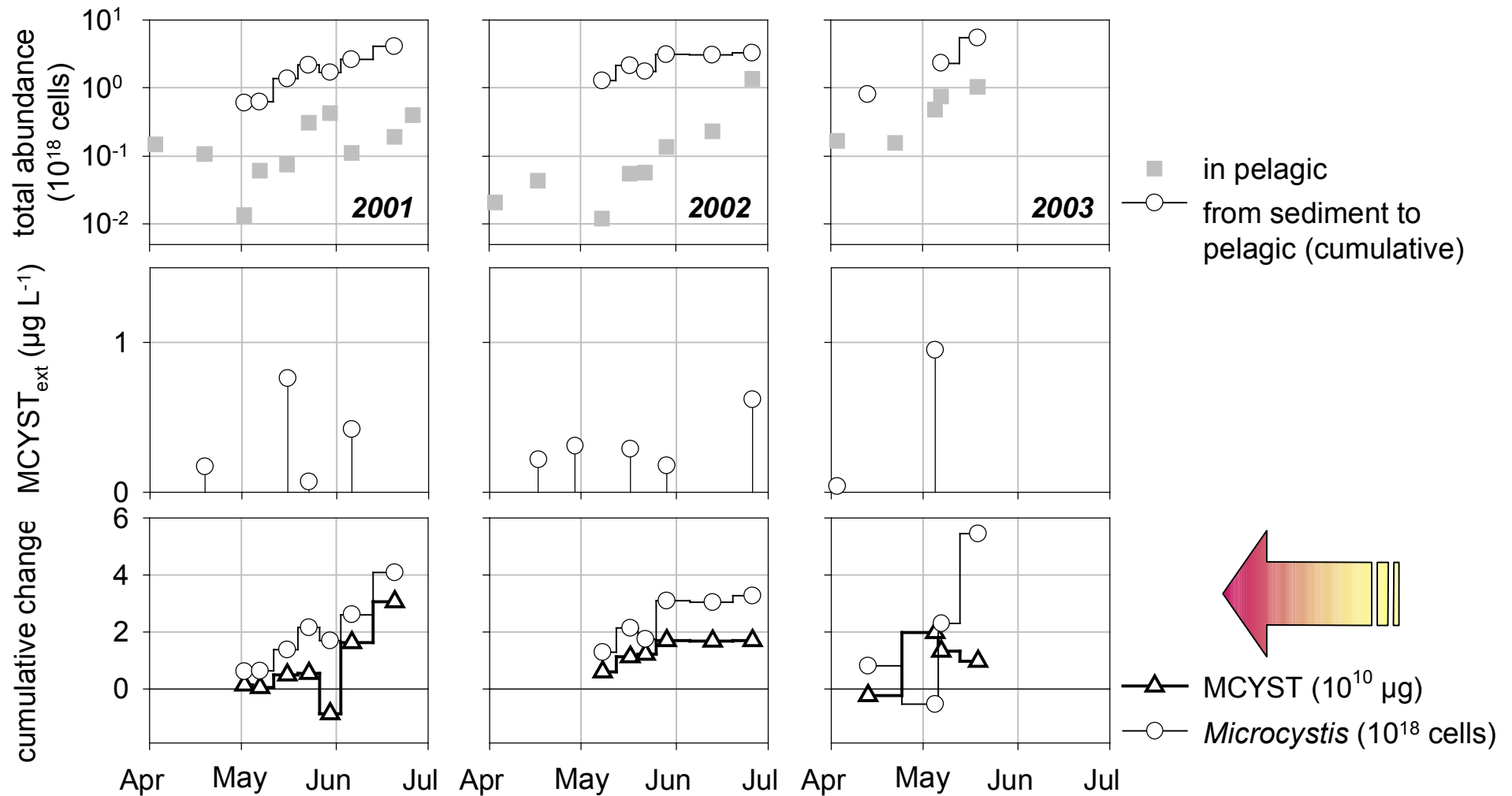
Reinvasion: *Microcystis* cells - pelagic vs. sediment



Reinvasion: extracellular MCYST in pelagic



Reinvasion: *Microcystis* vs. intracellular MCYST within the sediment

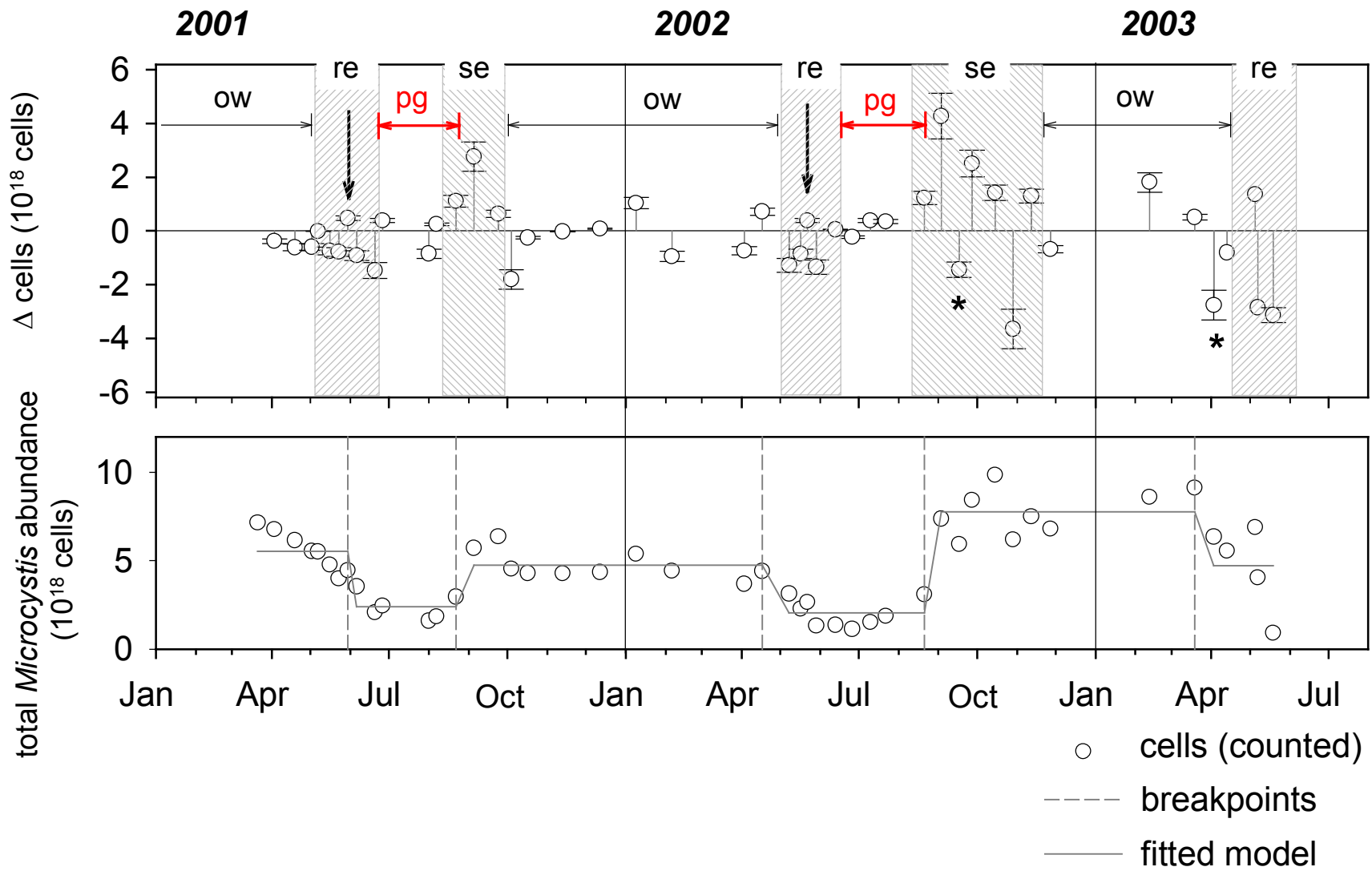


reinvasion of *Microcystis* & MCYST is not time-synchronous

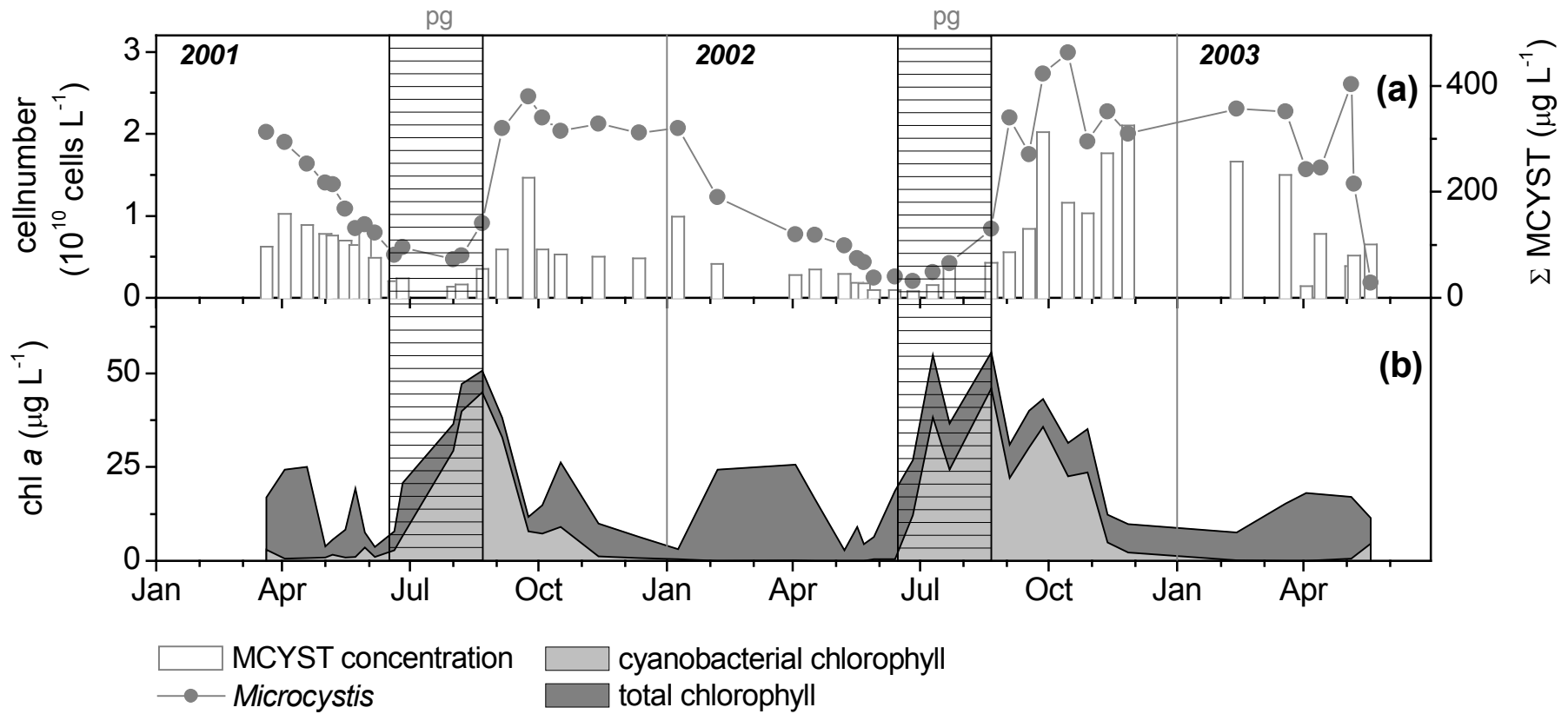


changing of pelagic & benthic MCYST_{spez}

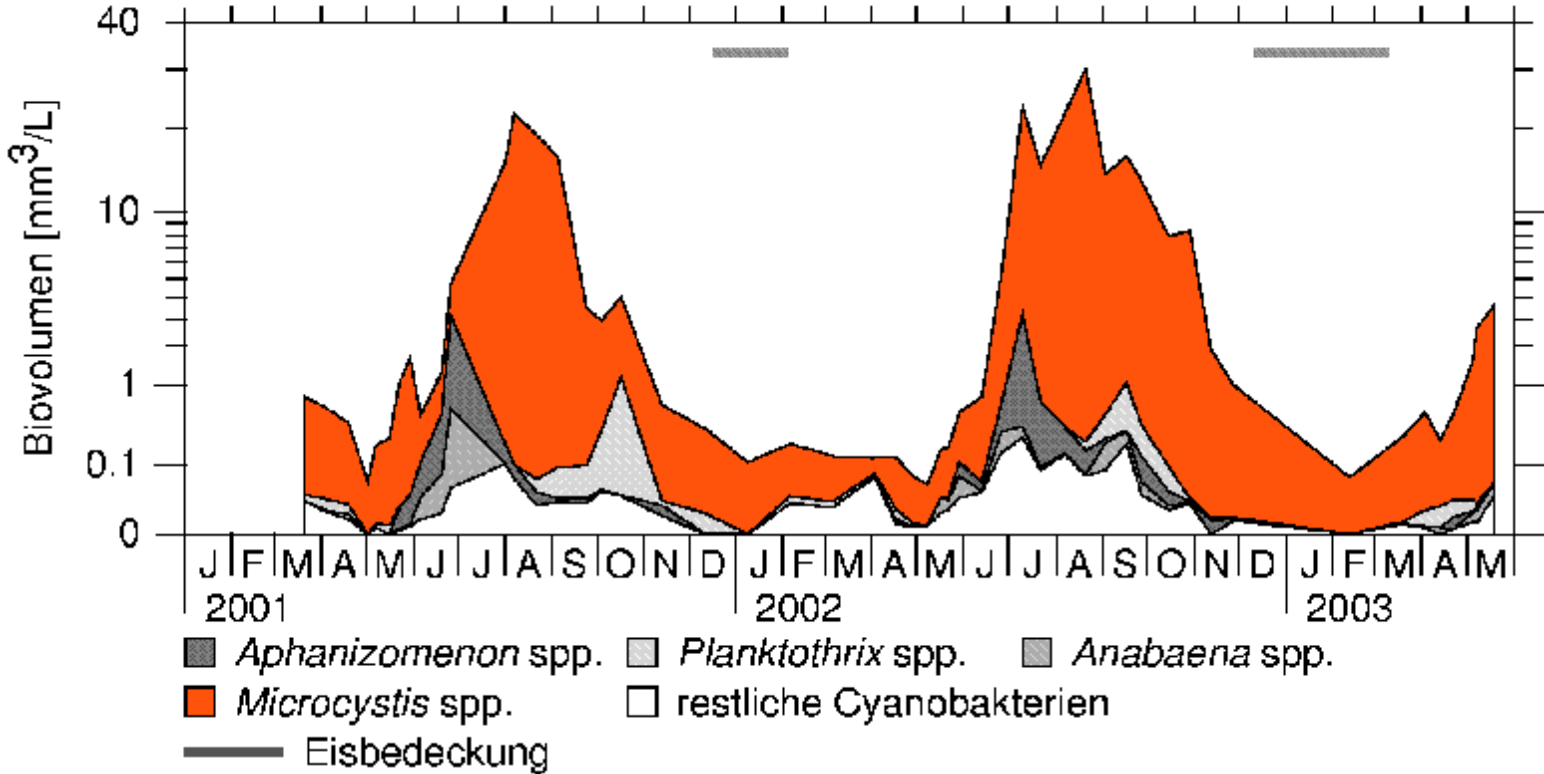
Phenological phases: pelagic growth



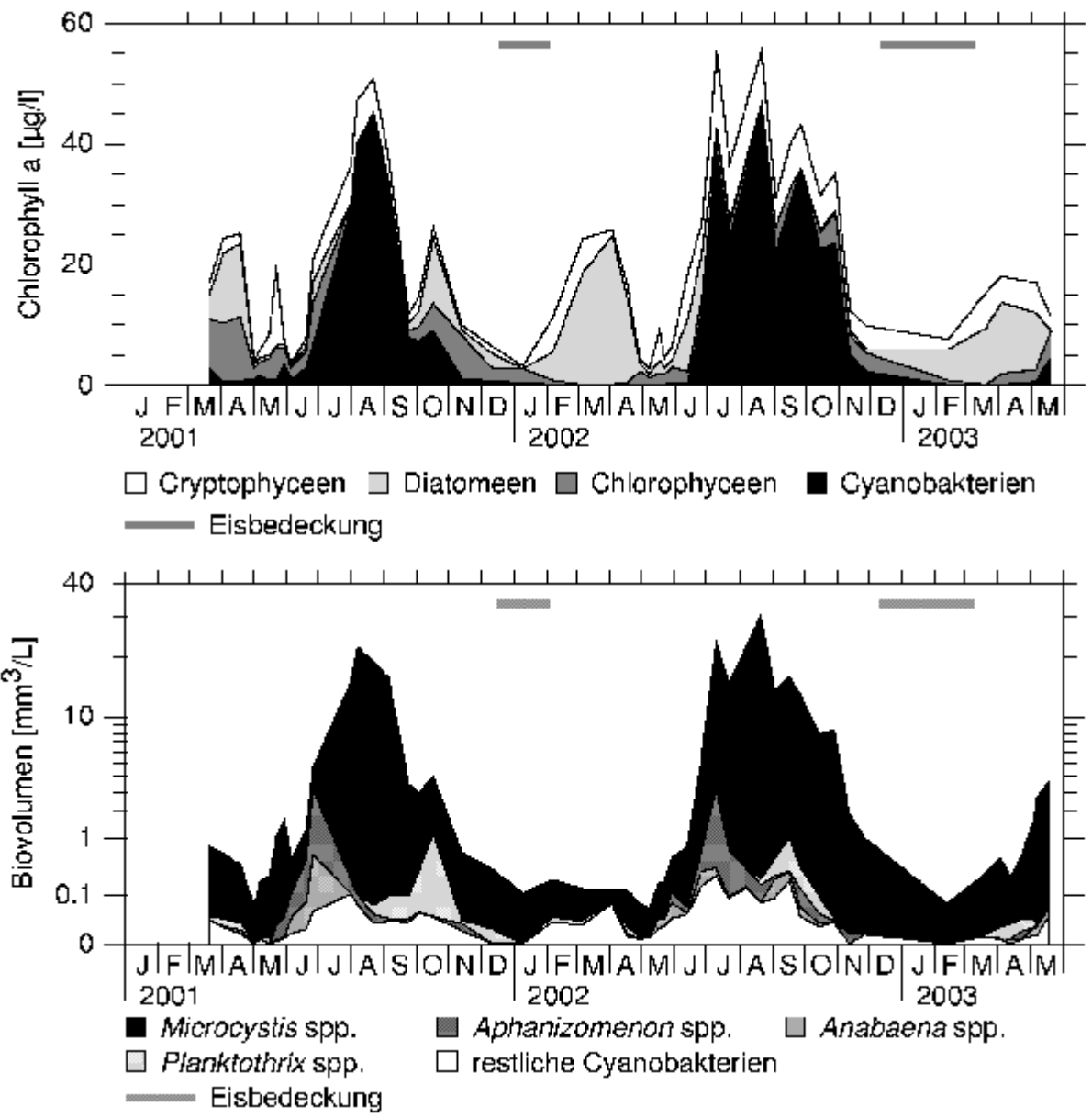
Pelagic growth: sediment vs. pelagic



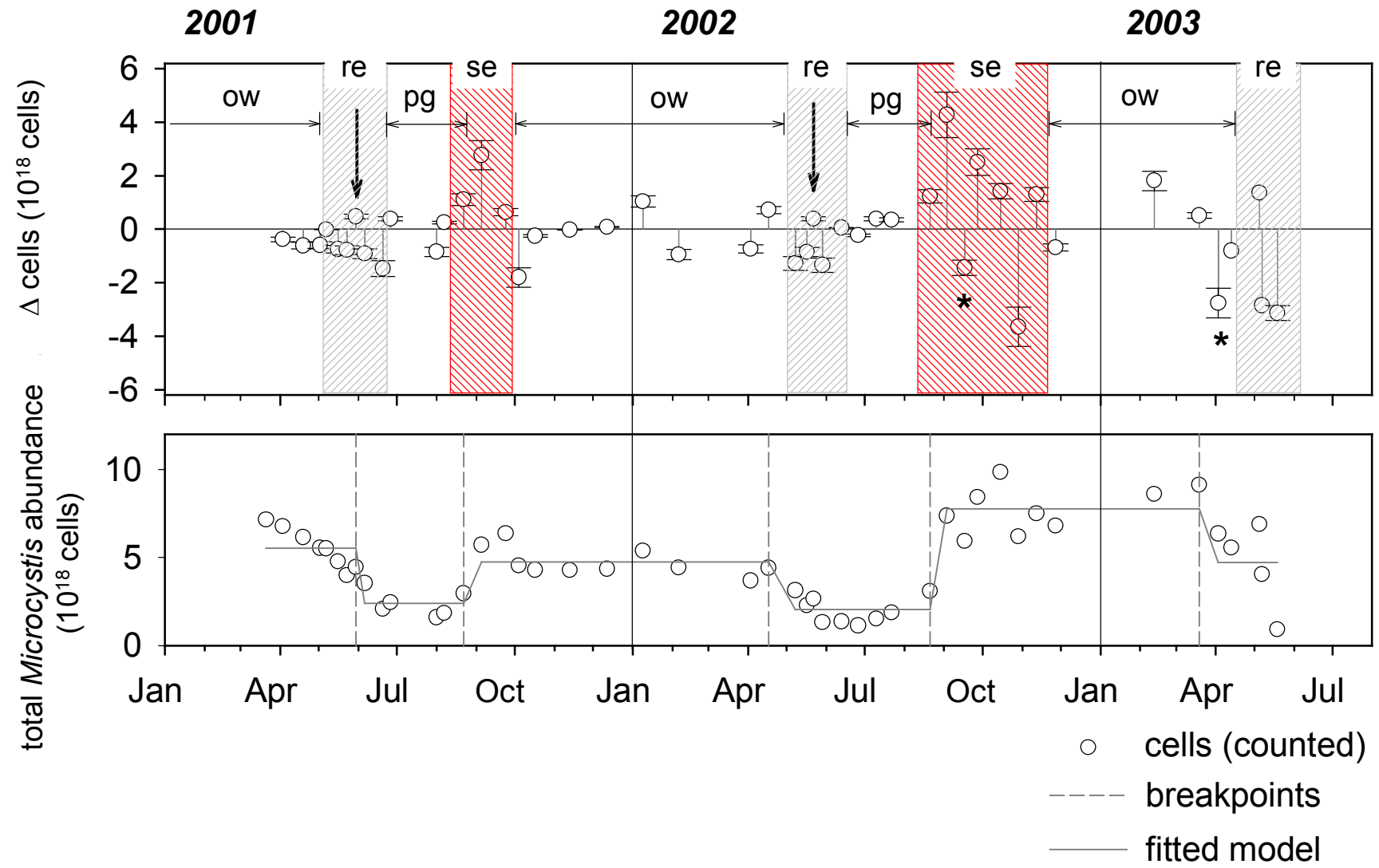
Pelagic growth: temporal pattern of cyanobacteria in the pelagic



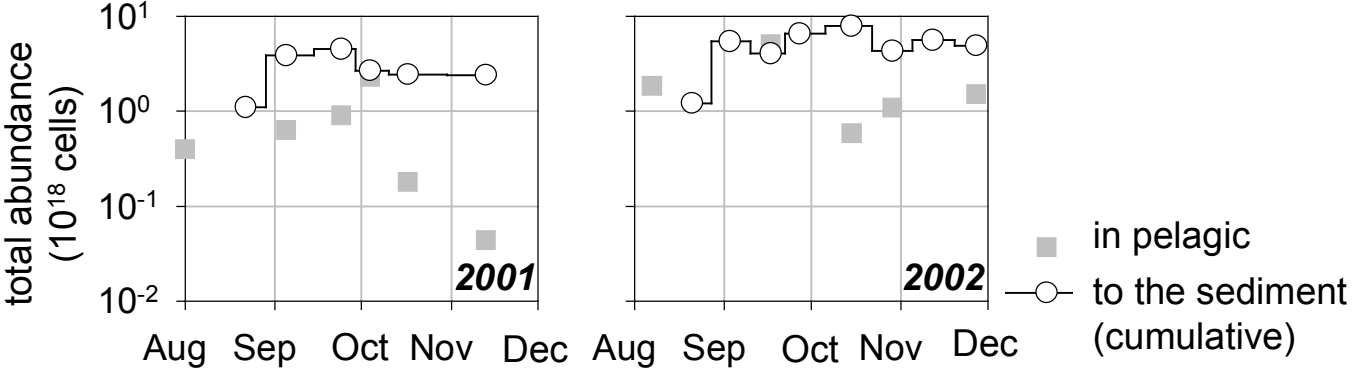
Spectral algal-groups of microalgae/biovolume of cyanobacteria



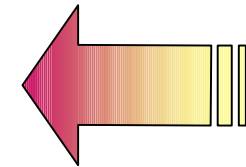
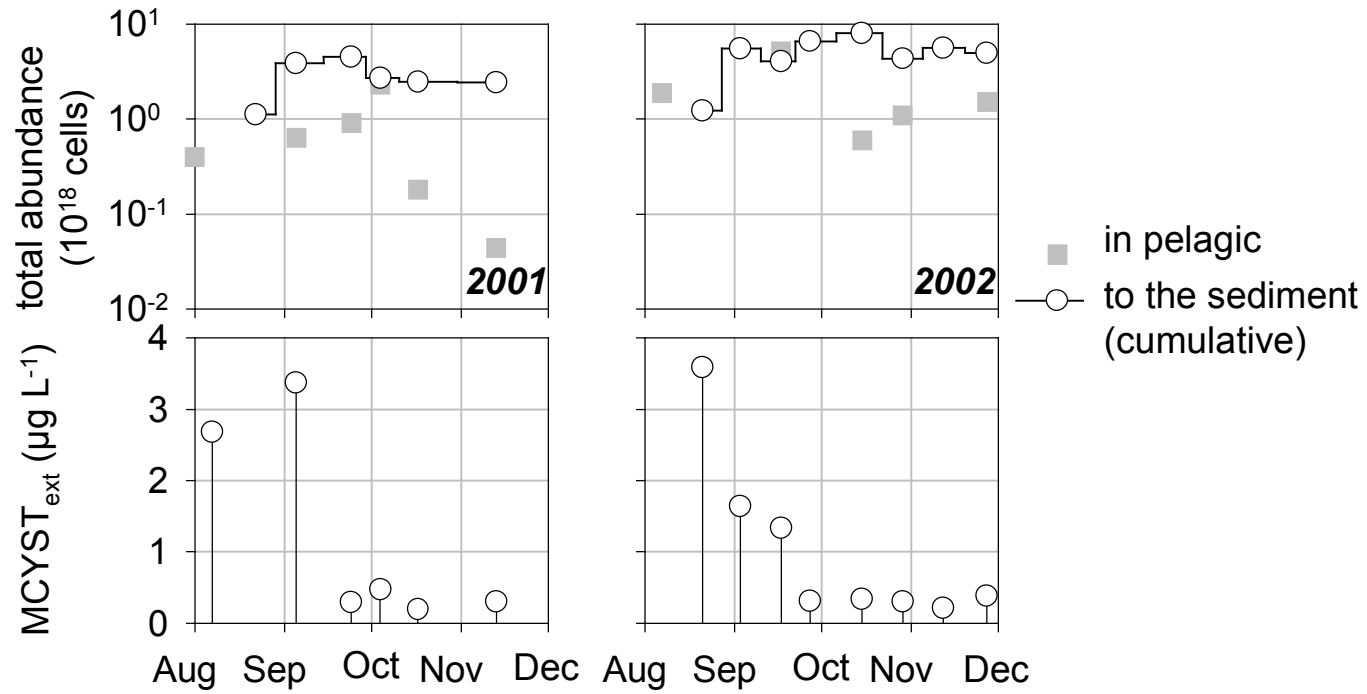
Phenological phases: sedimentation



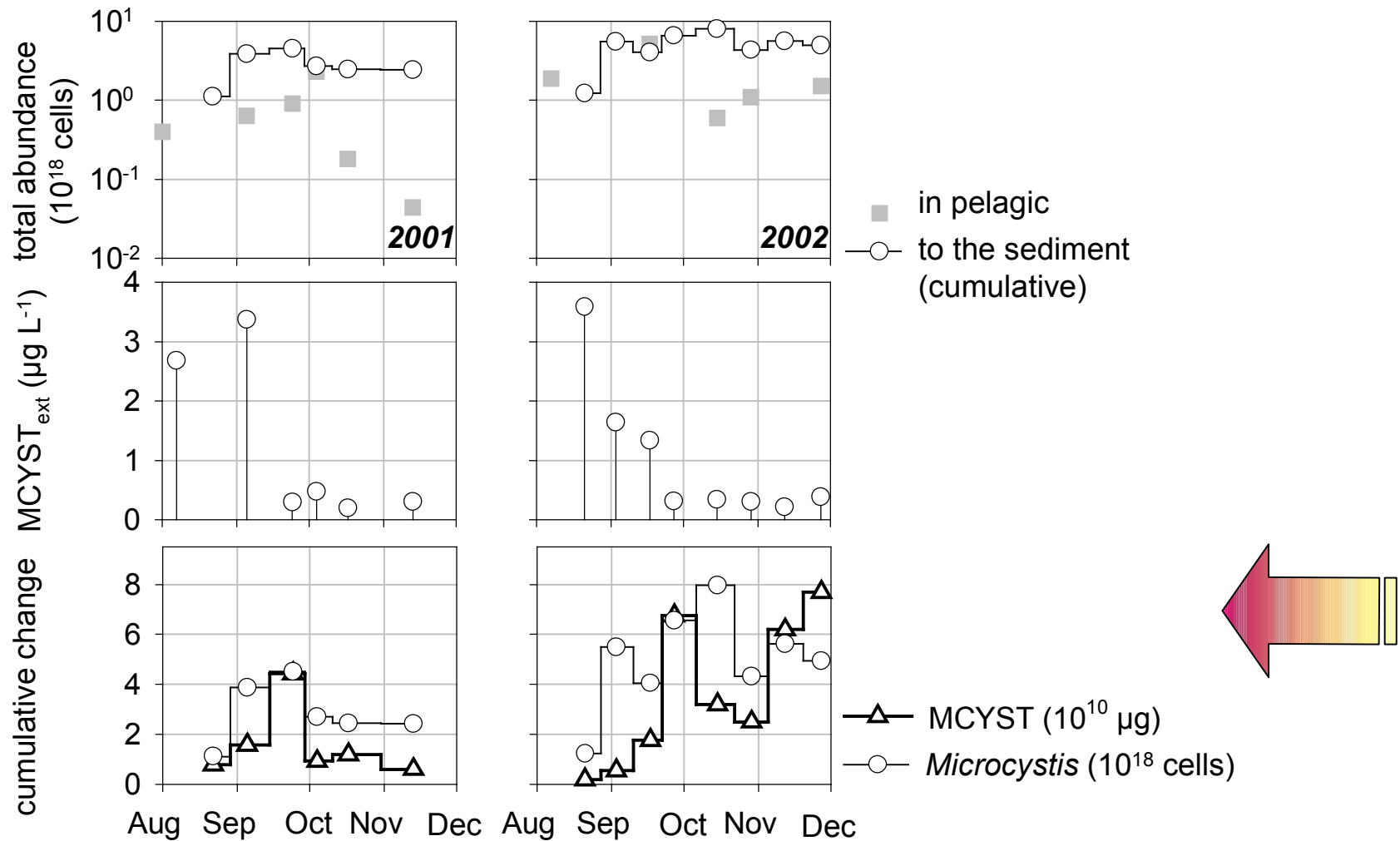
Sedimentation: *Microcystis* cells - pelagic vs. sediment



Sedimentation: extracellular MCYST in pelagic



Sedimentation: *Microcystis* vs. intracellular MCYST within the sediment

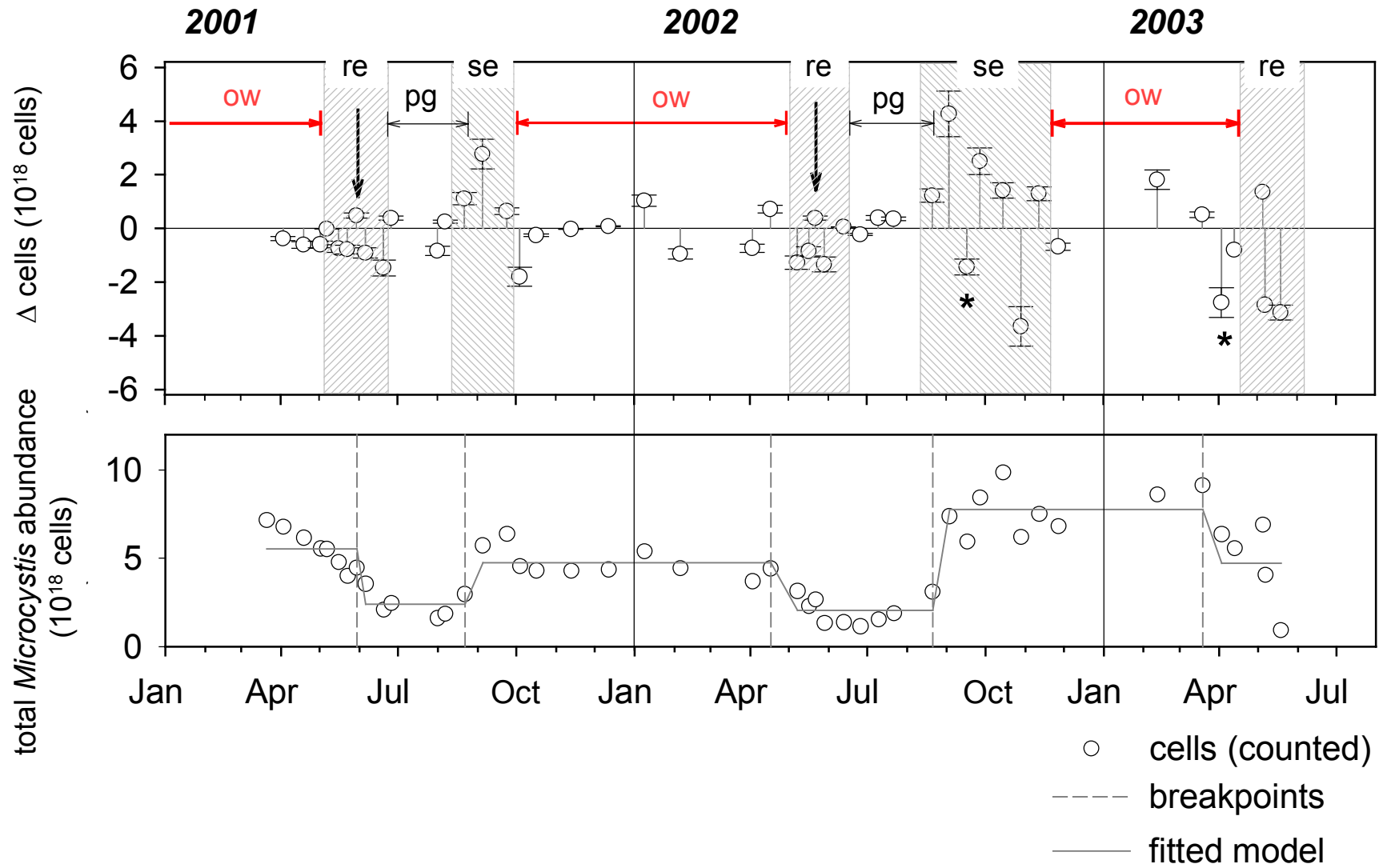


sedimentation of *Microcystis* & MCYST is not time-synchronous

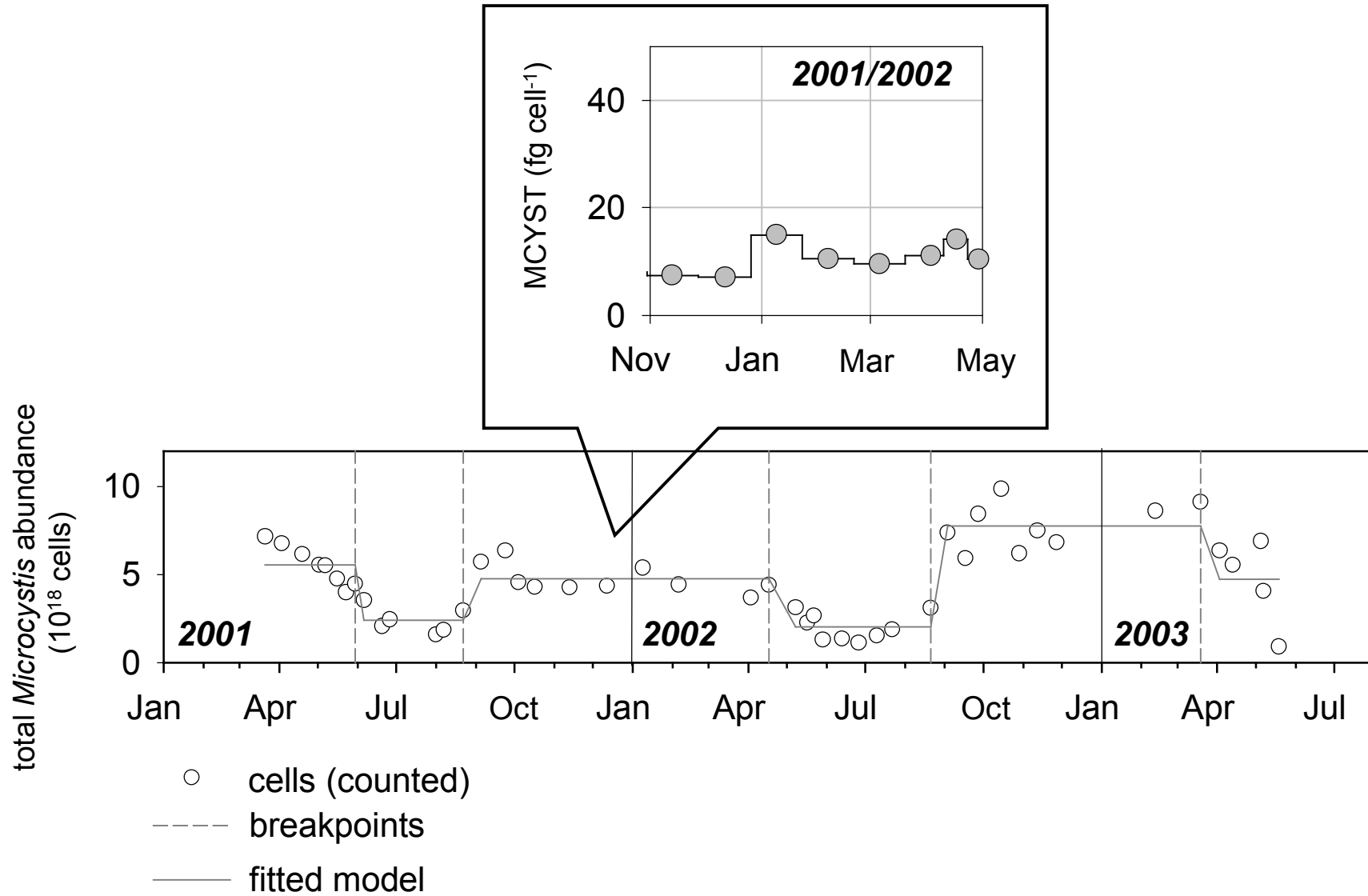


changing of pelagic & benthic MCYST_{spez}

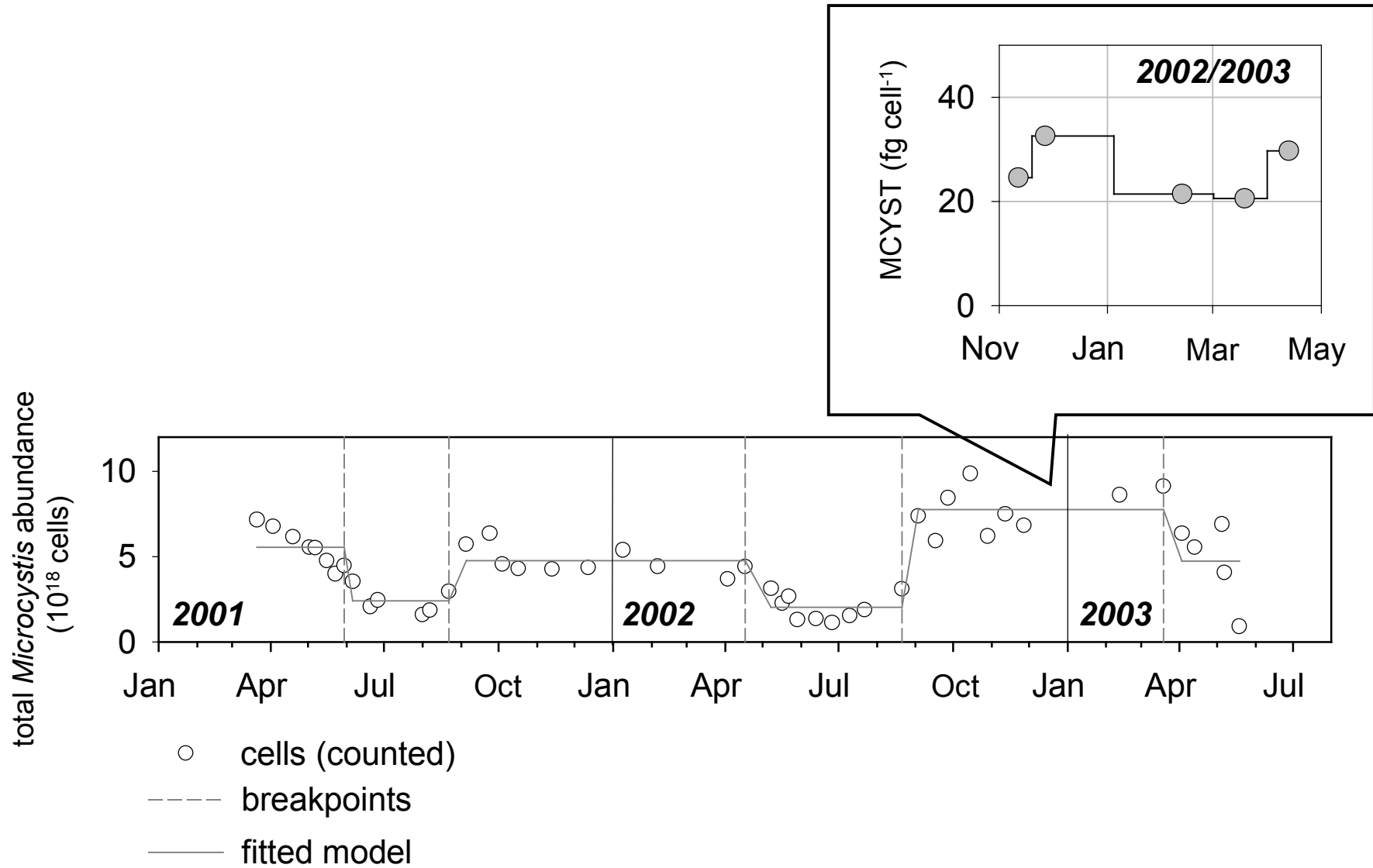
Phenological phases: overwintering

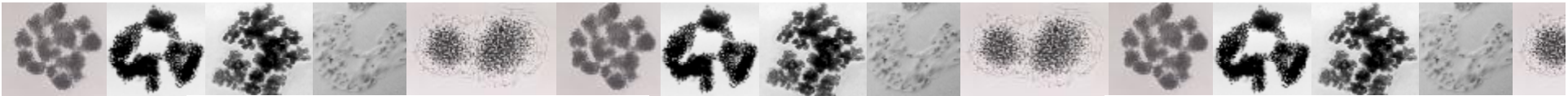


Overwintering: benthic MCYST - cell quota

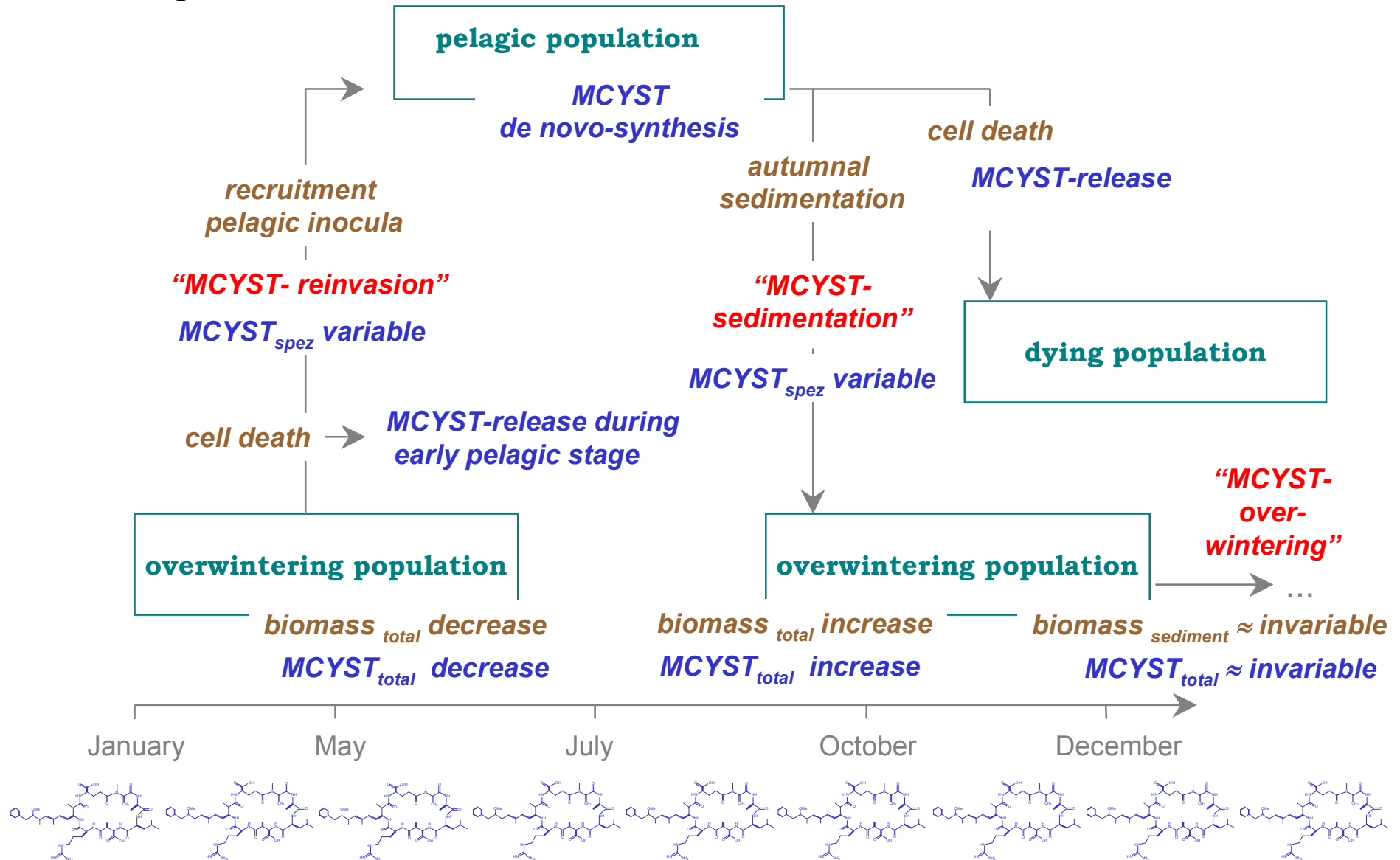


Overwintering: benthic MCYST - cell quota





Microcystis & MCYST: benthic-pelagic interactions have a temporal scale exceeding one season



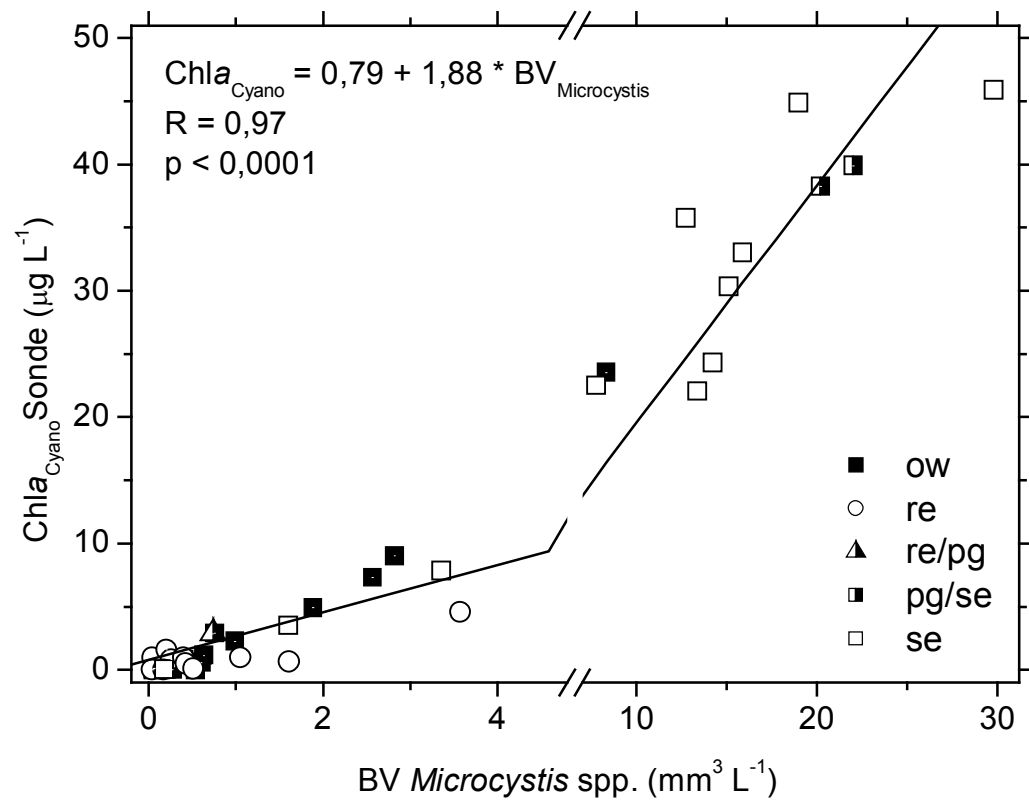


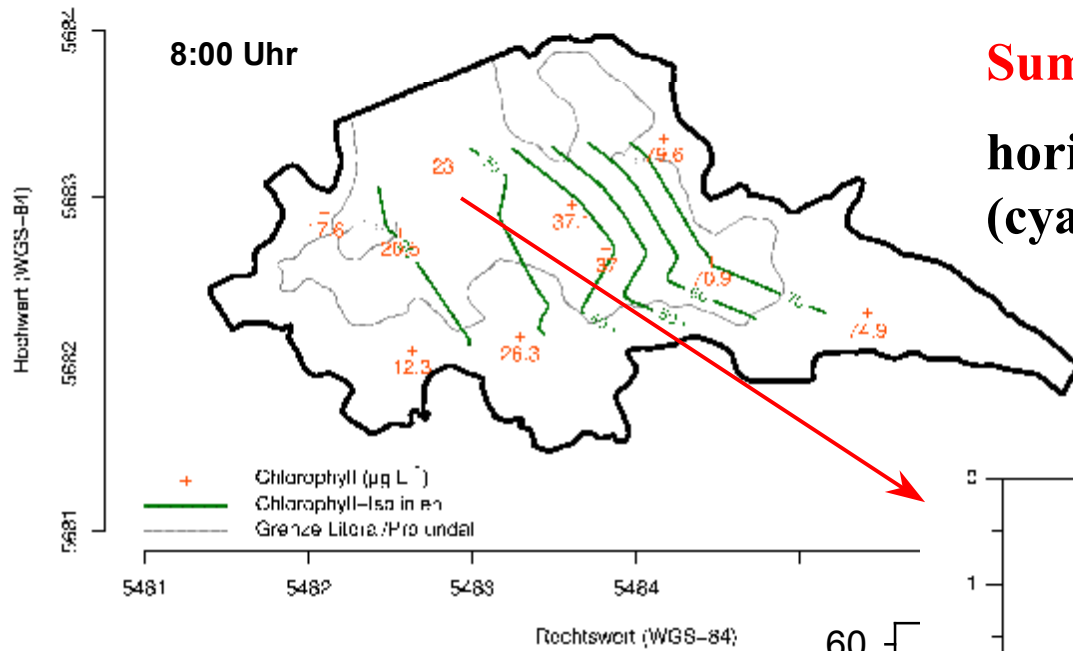
THANKX FOR YOUR ATTENTION !!





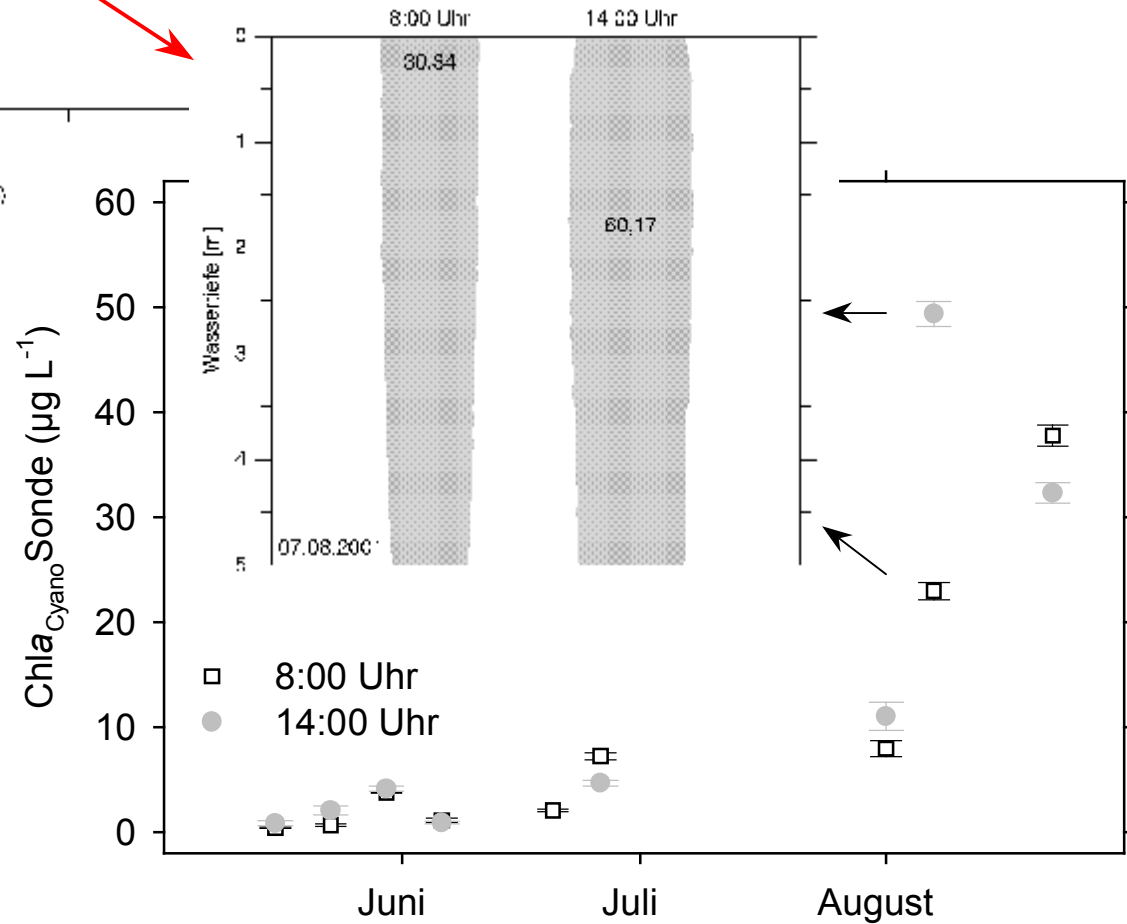
**EPILOGUE – doin’ some
bbe promotion ;-)**

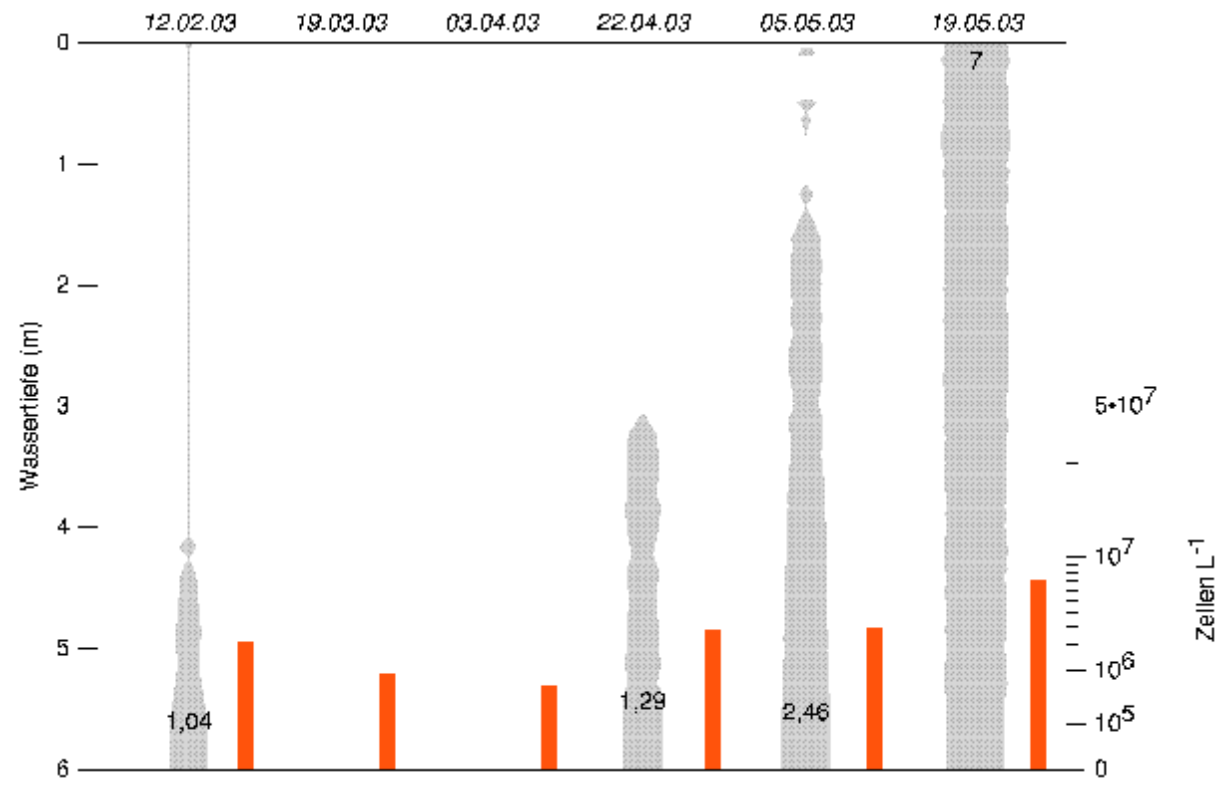




**Summer of 2001 – patchiness events:
horizontal/vertical inhomogenities
(cyanobacterial chlorophyll)**

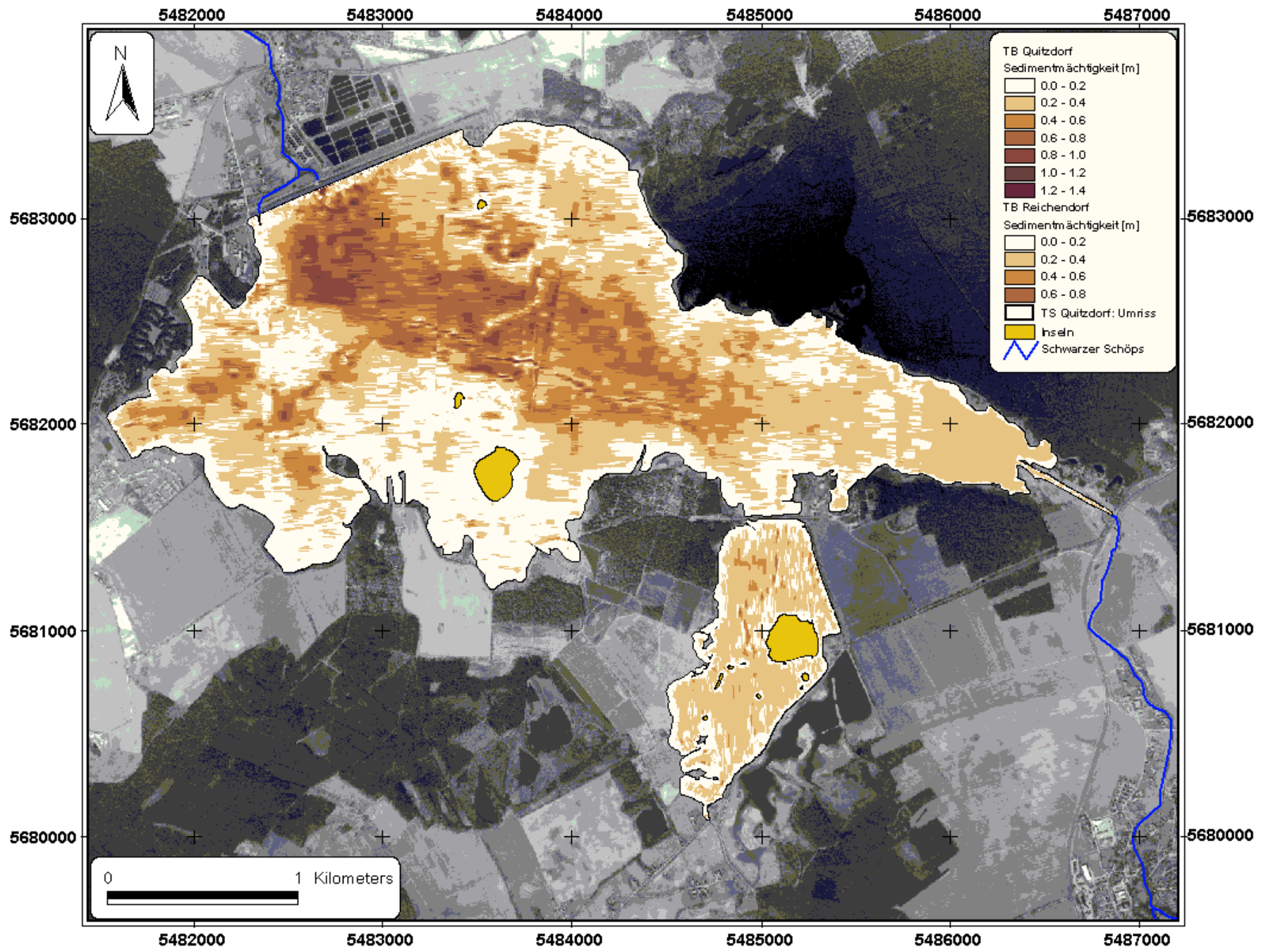
07/08/2001





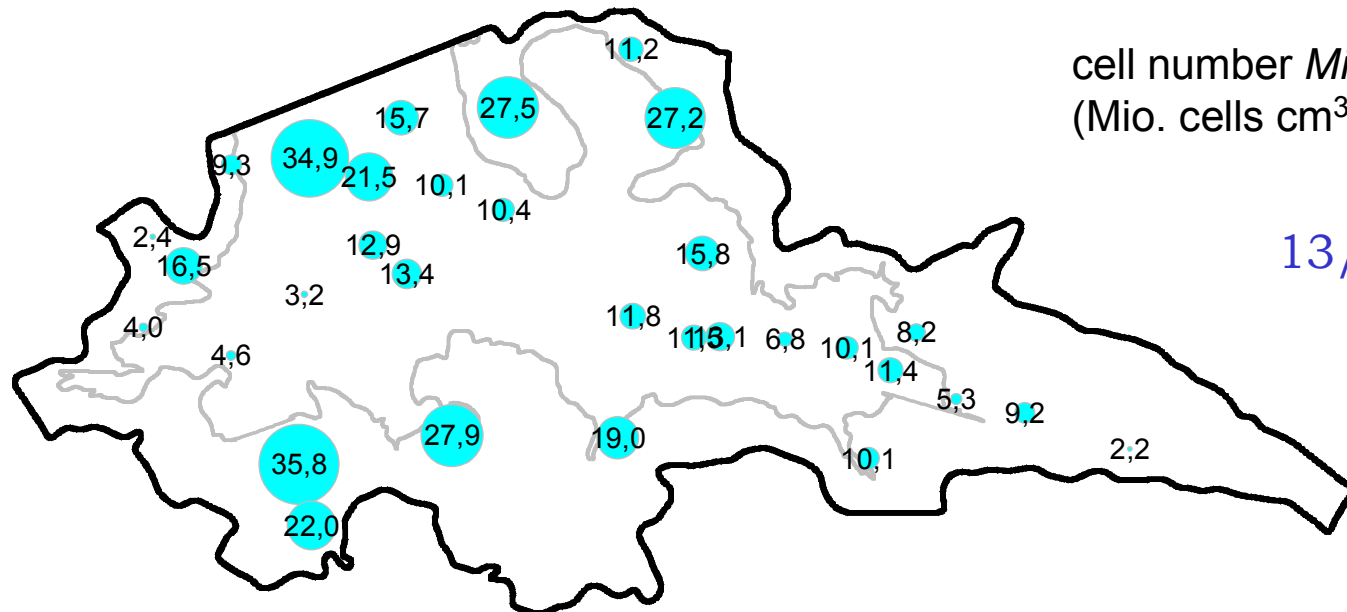


APPENDIX

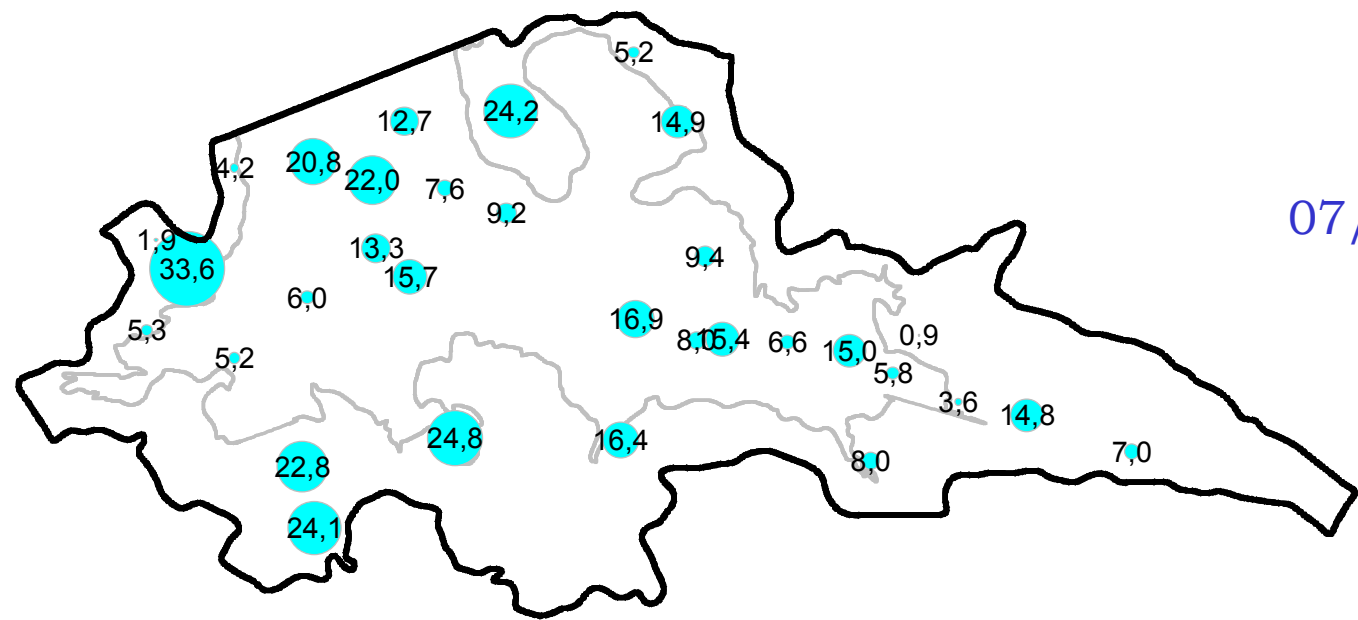


Microcystis - spatial distribution during spring 2003

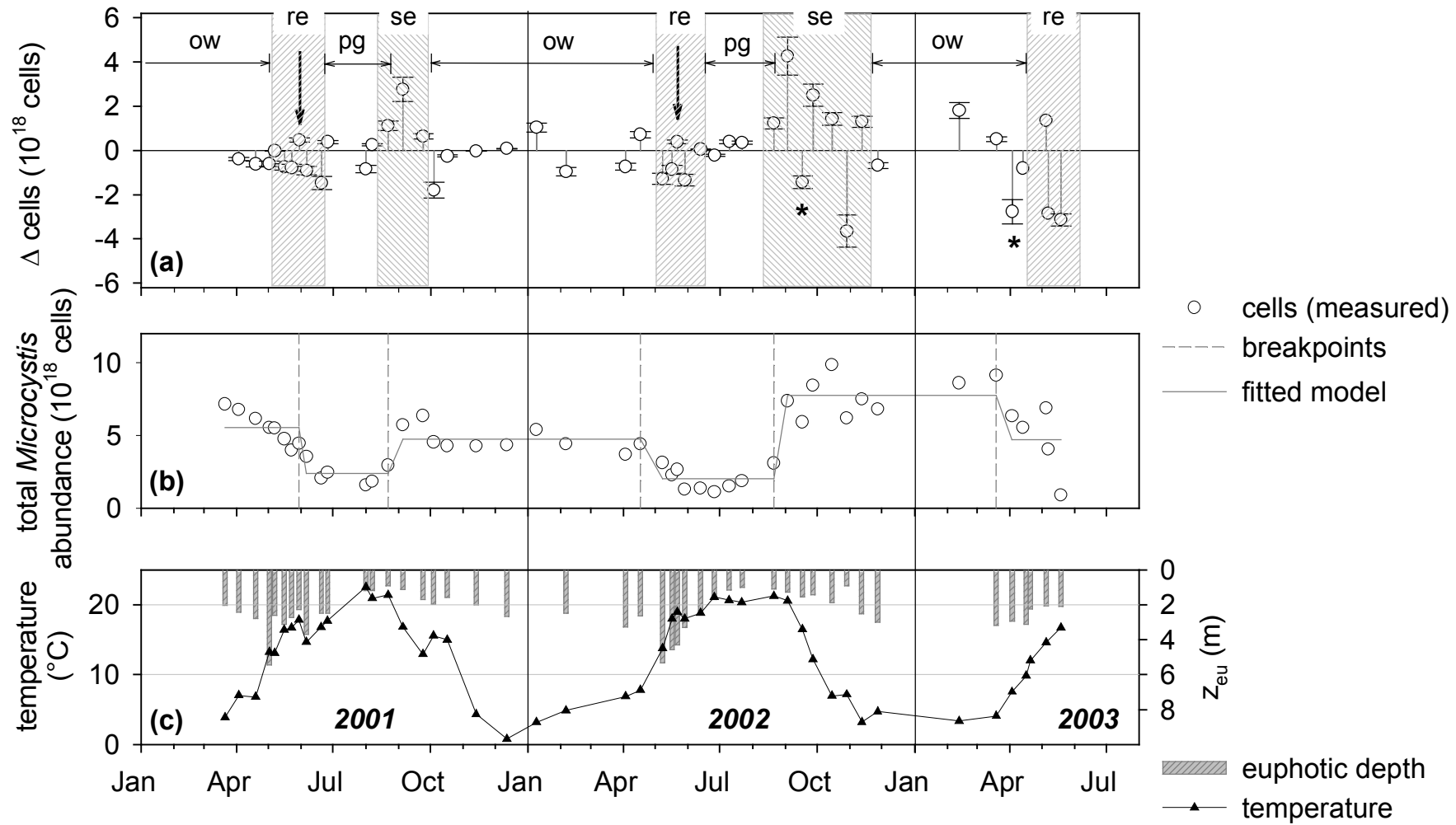
cell number *Microcystis* spp.
(Mio. cells cm³)

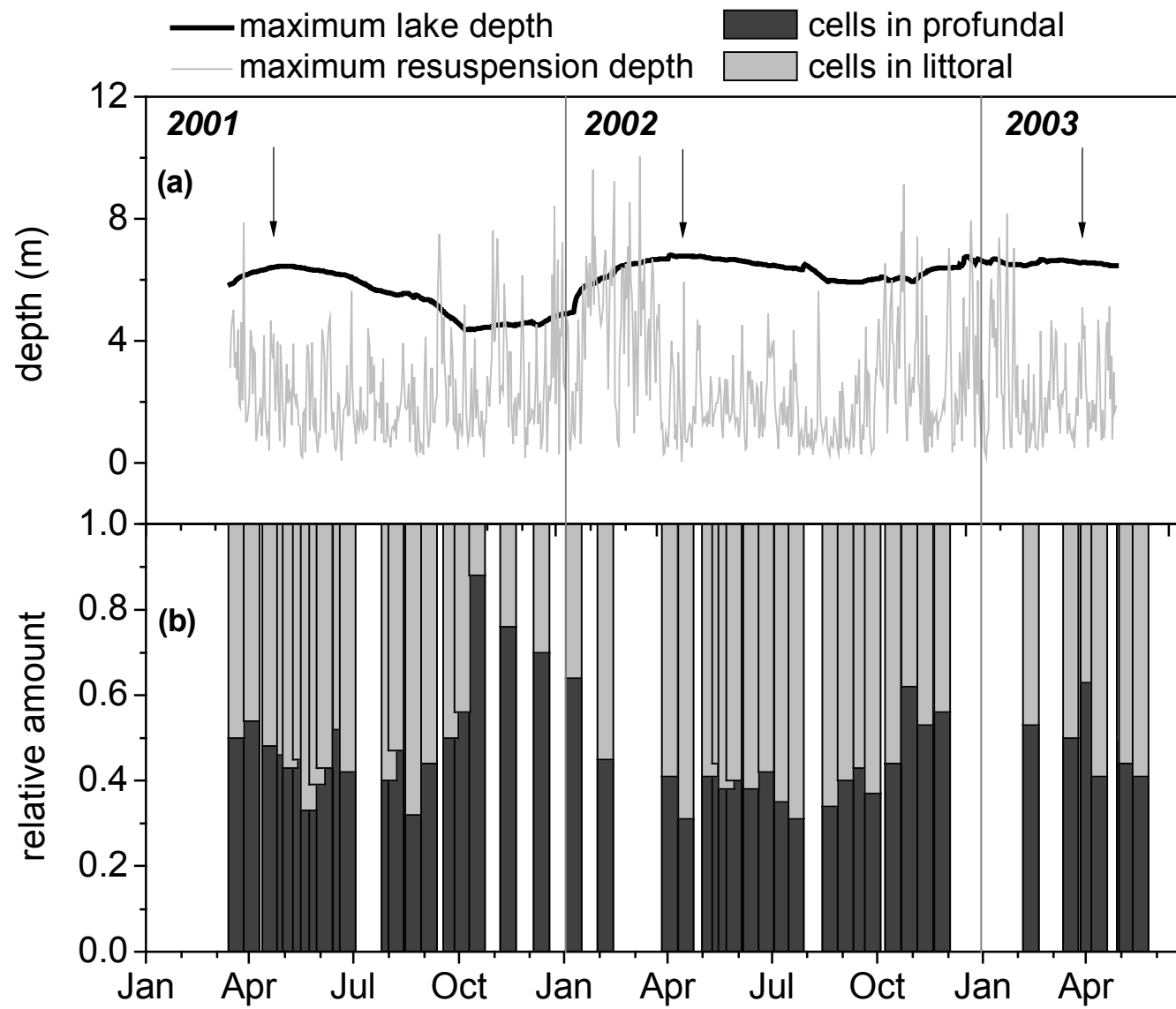


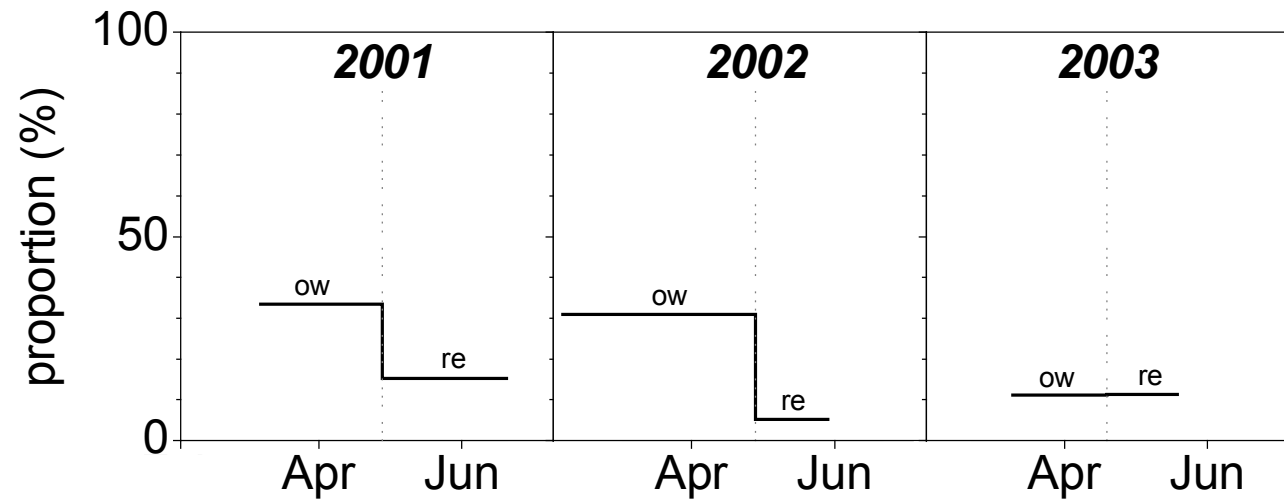
13/04/2003

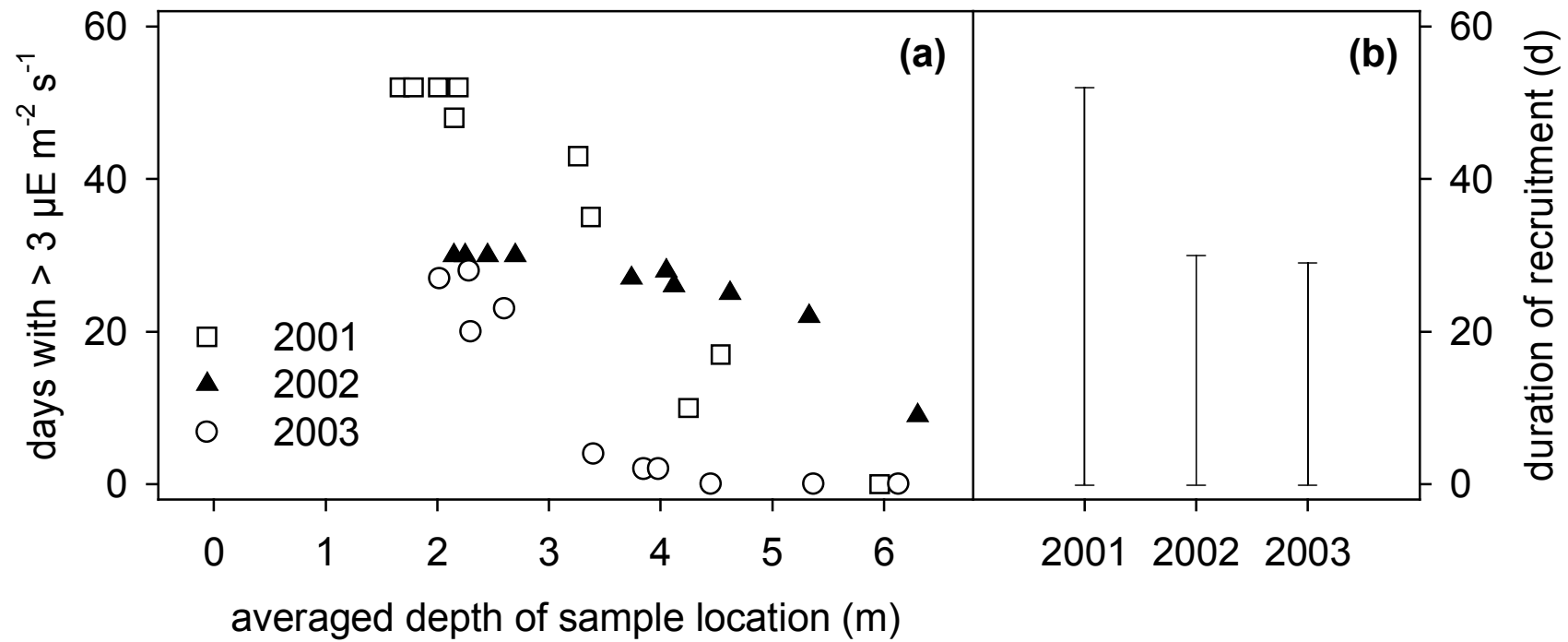


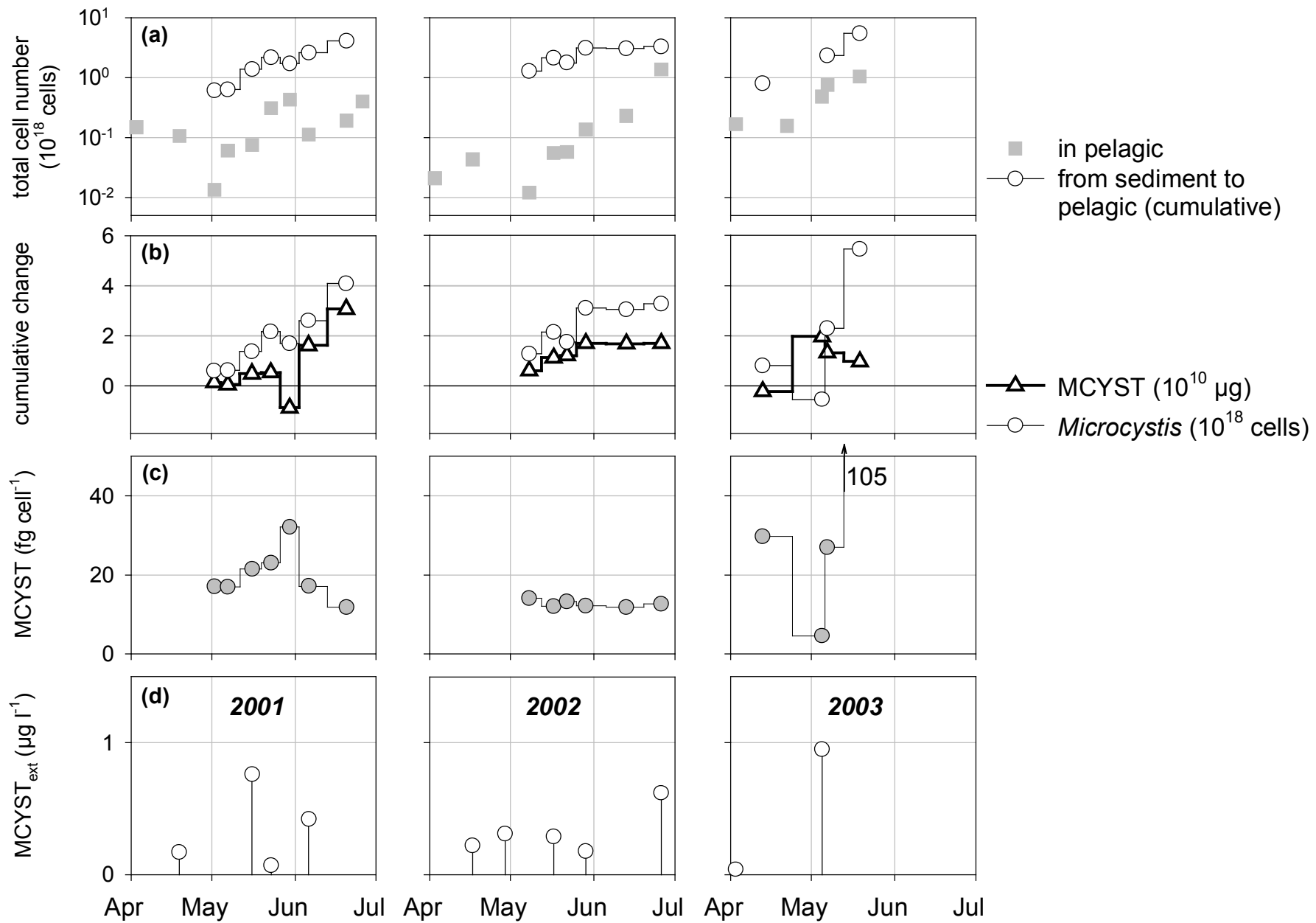
07/05/2003

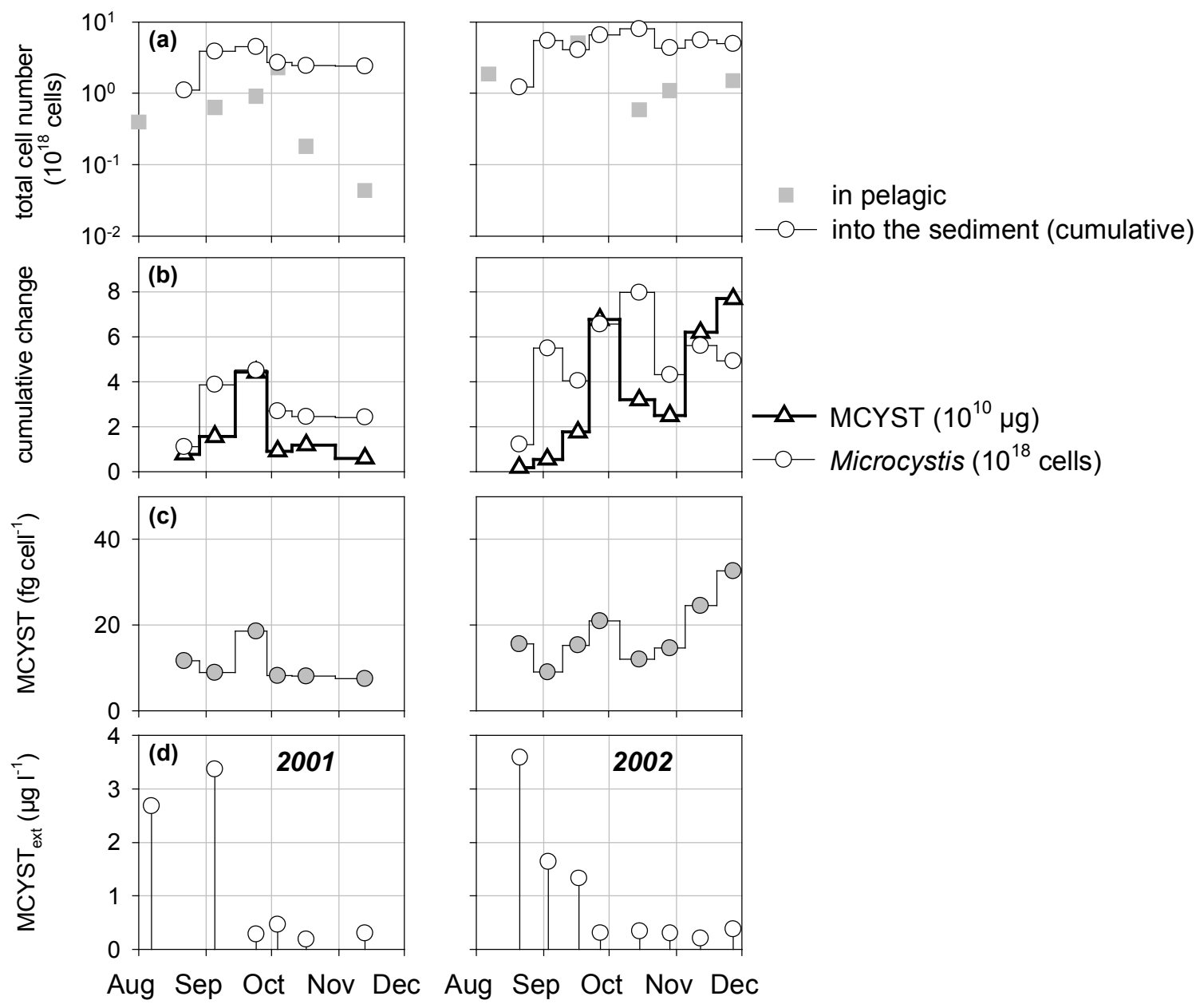


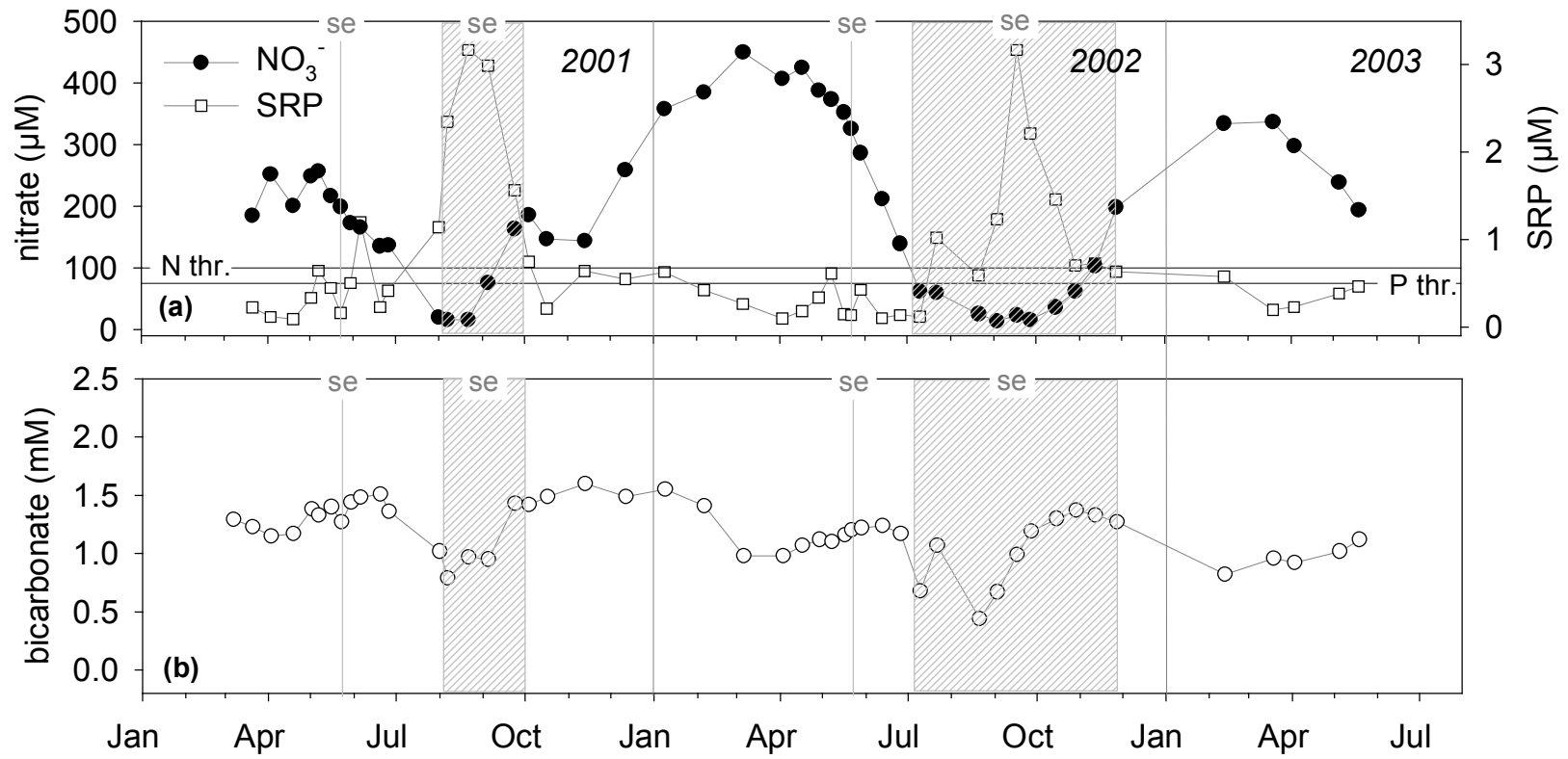


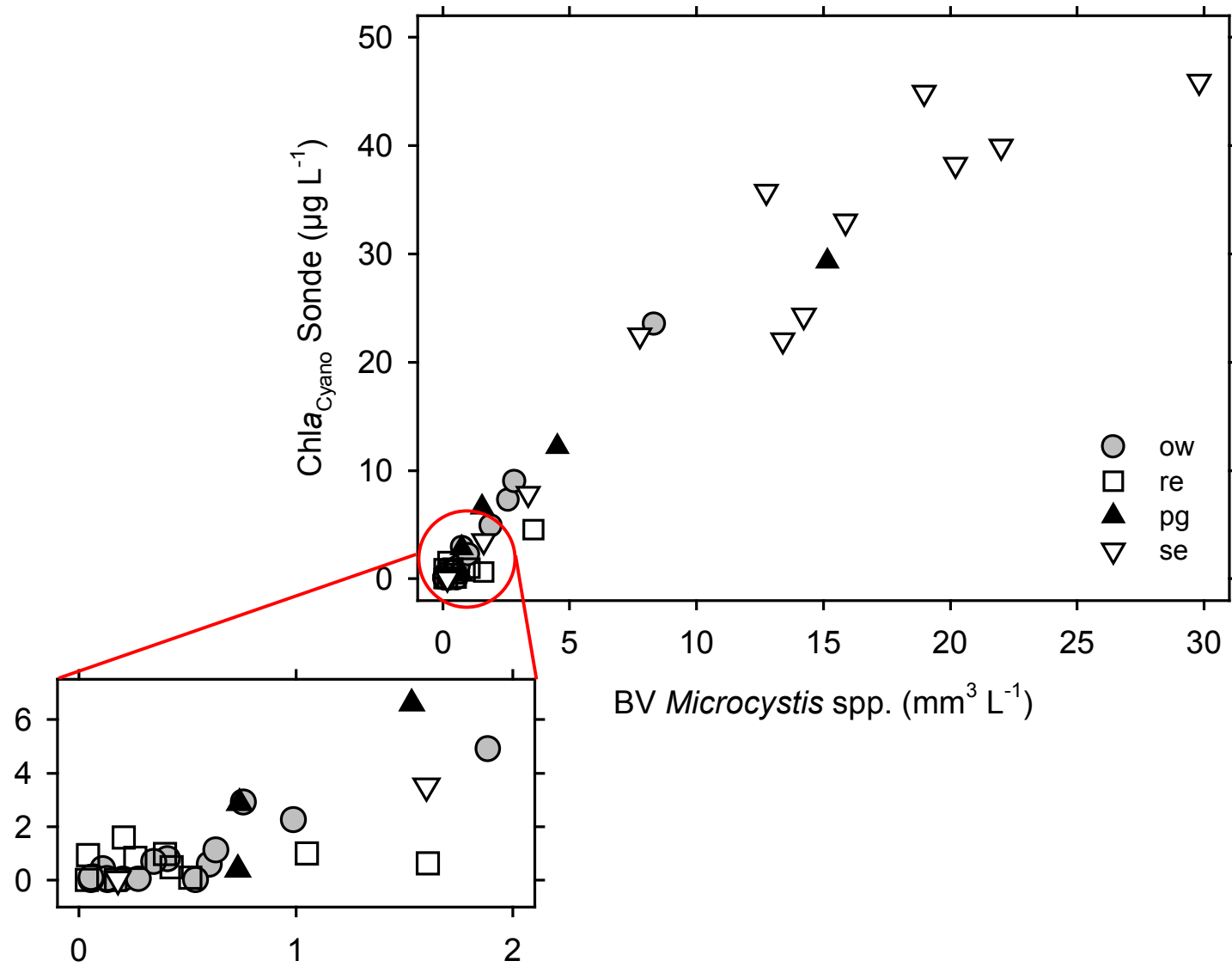












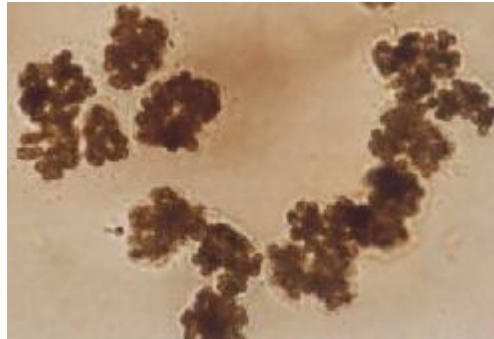
Heterogeneity of *Microcystis* - blooms



Microcystis – “morphospecies” of Quitzdorf Reservoir



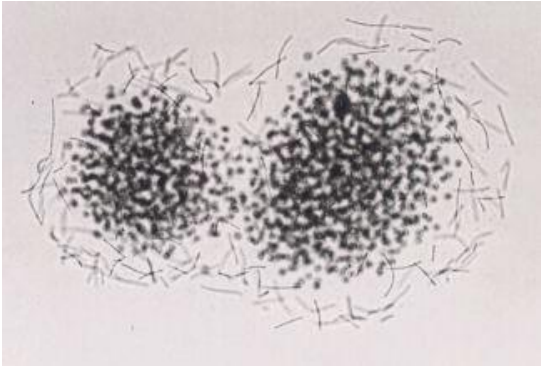
Microcystis aeruginosa



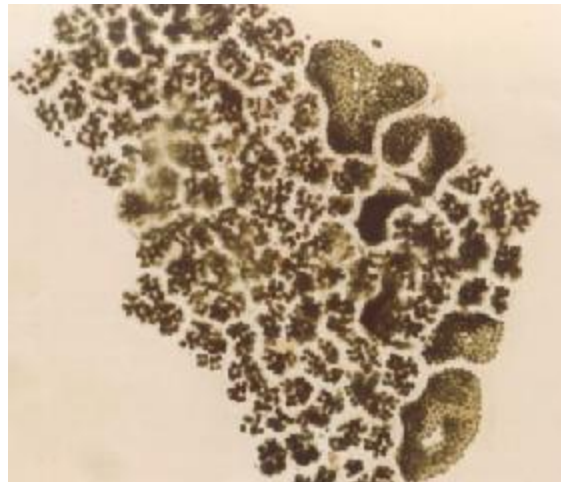
Microcystis viridis



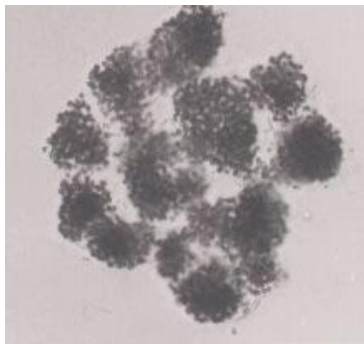
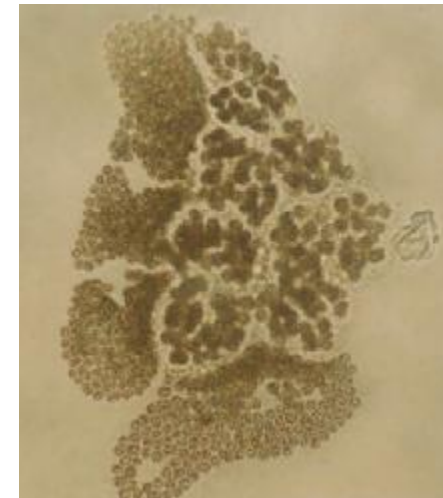
Microcystis wesenbergii



Microcystis botrys

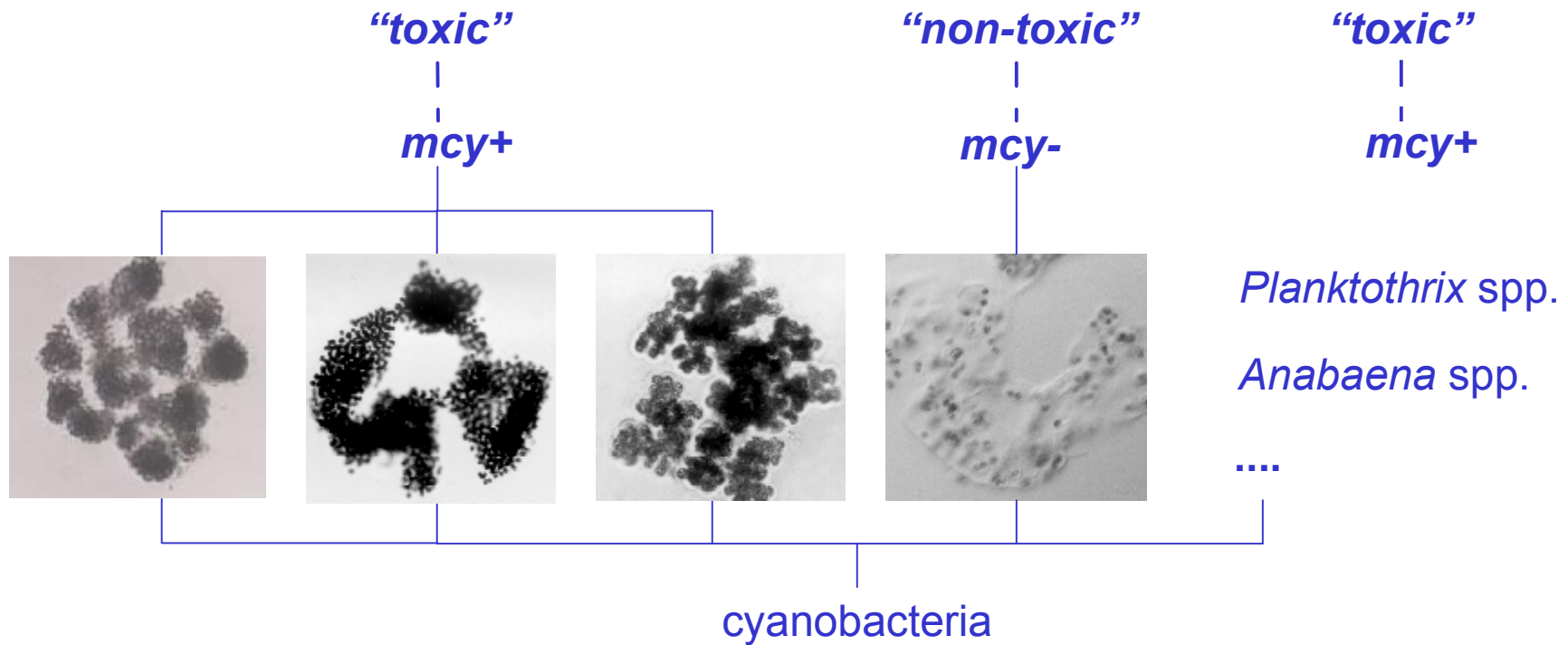
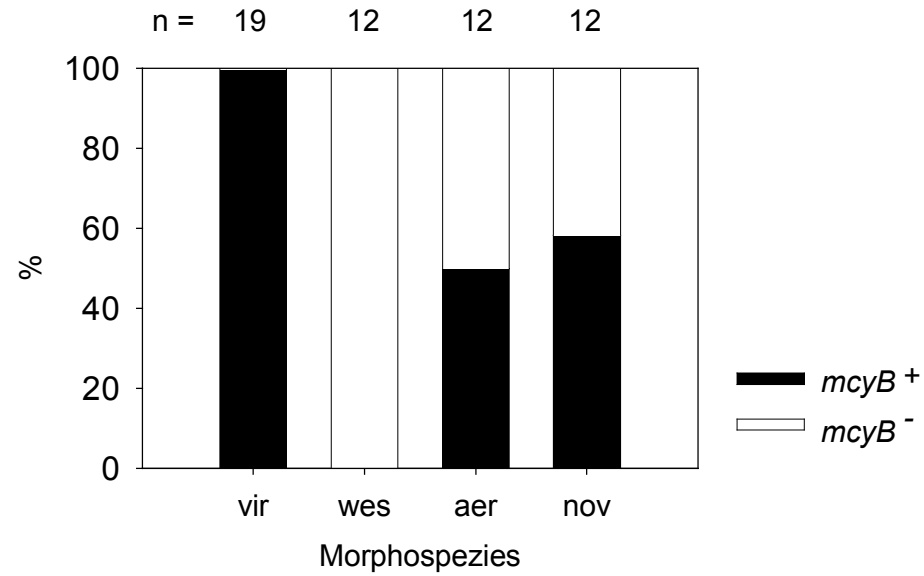


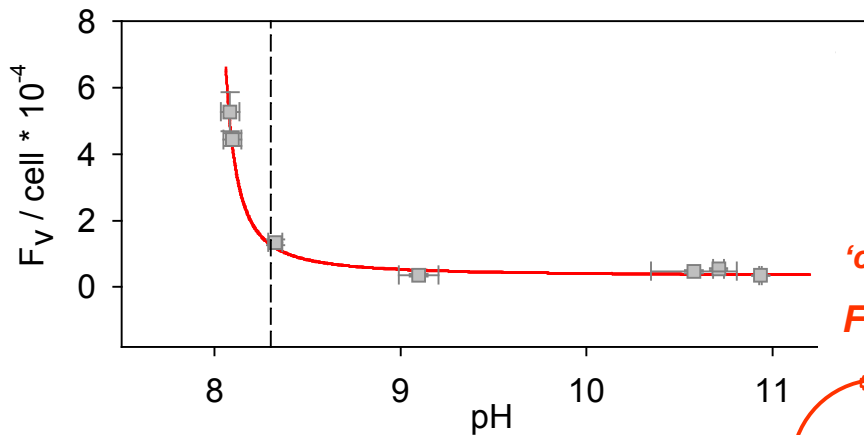
„*Microcystis quitzdorfii*“



Microcystis novacekii

“To be or not to be”: *Microcystis* - morphospecies vs. *mcy B* - genotype





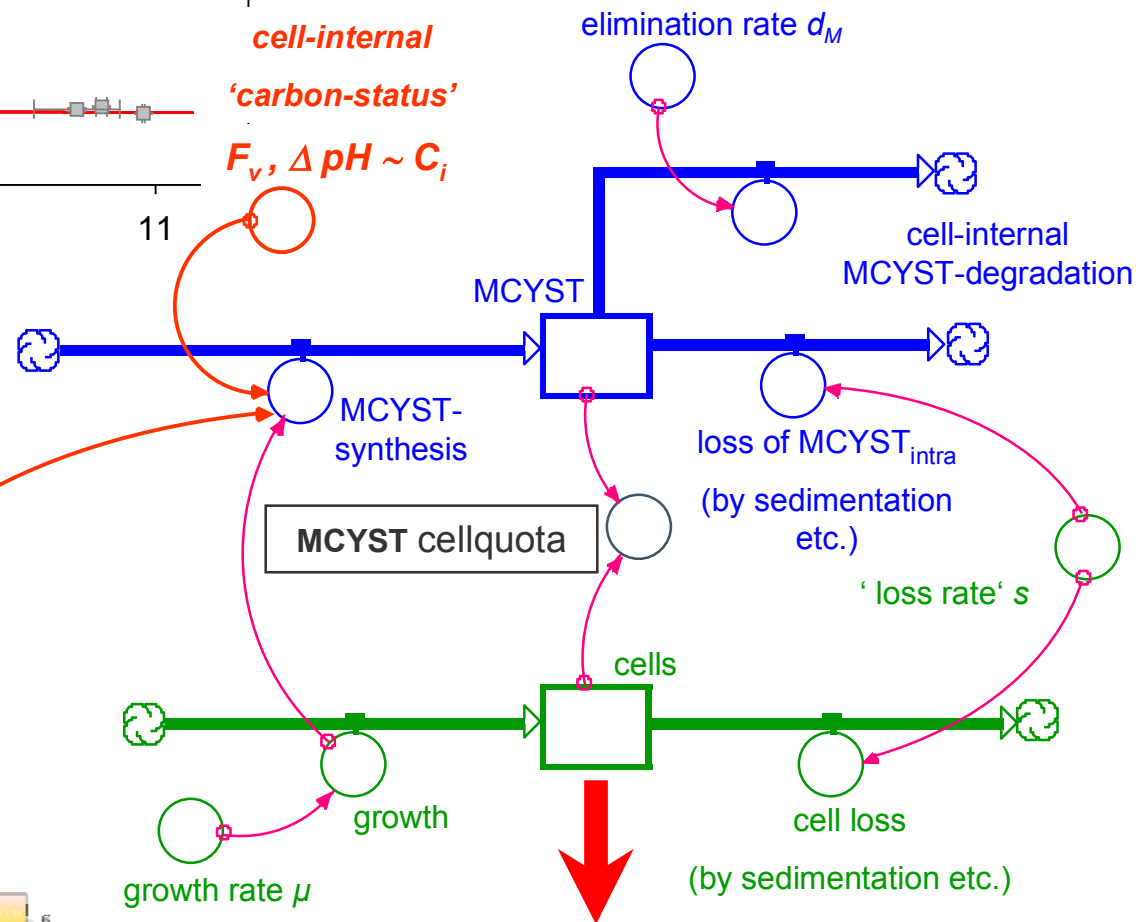
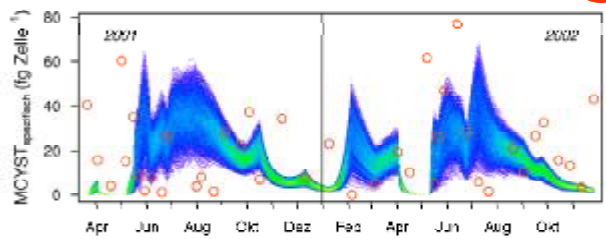
cell-internal
'carbon-status'
 $F_V, \Delta pH \sim C_i$

$$\frac{dM}{dt} = p \cdot \mu \cdot X - s \cdot M - d_M \cdot M$$

$$MCYST_i = f(\mu_i)$$

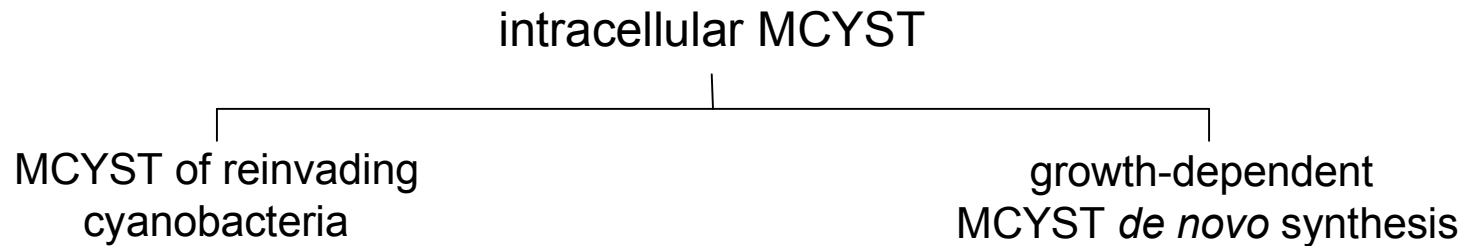
$$\frac{dX}{dt} = \mu \cdot X - s \cdot X$$

MCYST production co-efficient p



$$MCYST_{\text{spezific}} = \frac{\sum_{i=1}^n MCYST}{\sum_{i=1}^n biomass}$$

MCYST - mass balance



1.

$$\text{intracellular}_{\text{calculated}} =$$

Δ intracellular_{sediment}

+

intracellular_{growth}

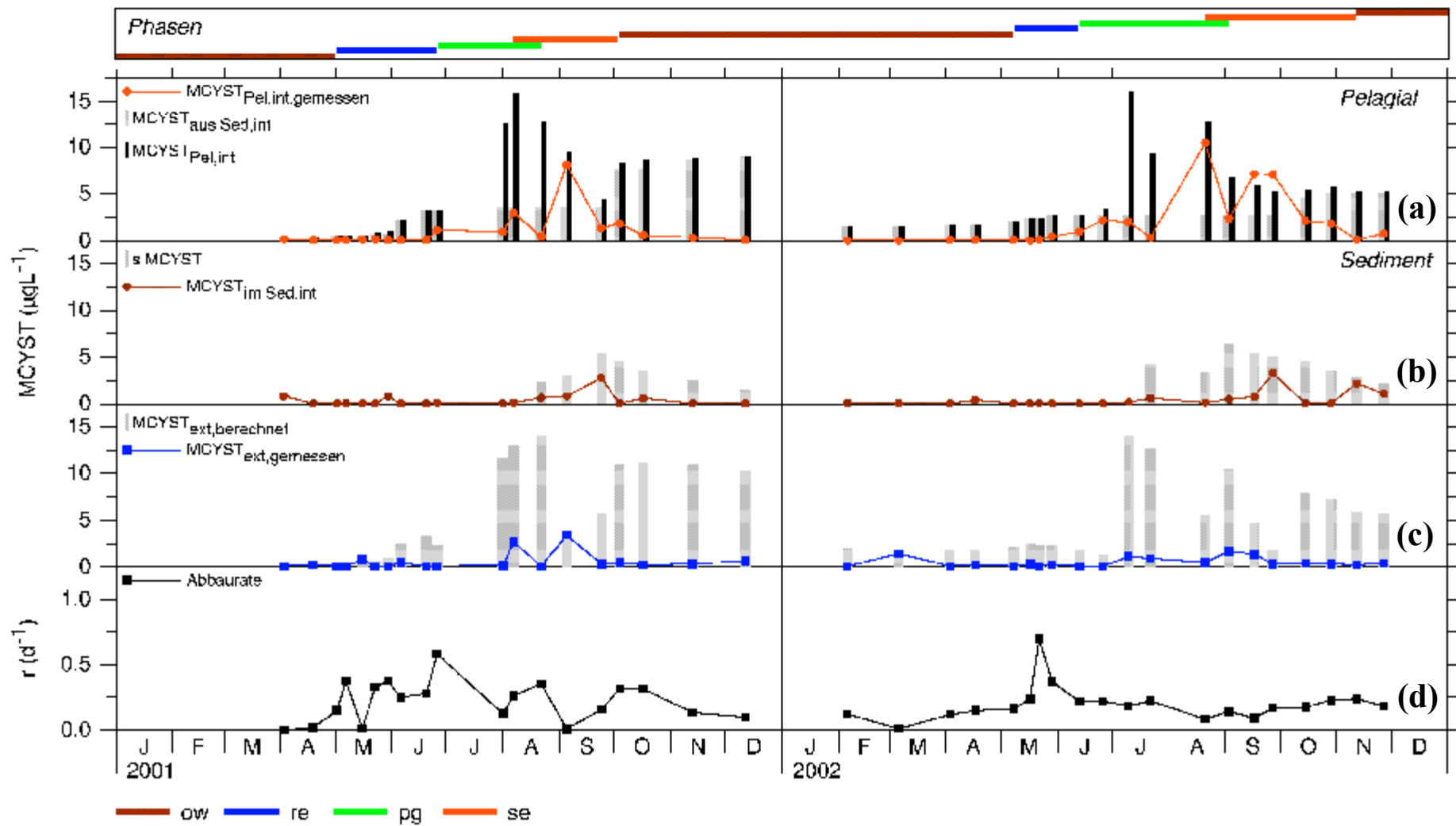
2.

$$\text{extracellular}_{\text{calculated}} = \text{intracellular}_{\text{calculated}} - \text{intracellular}_{\text{measured}}$$

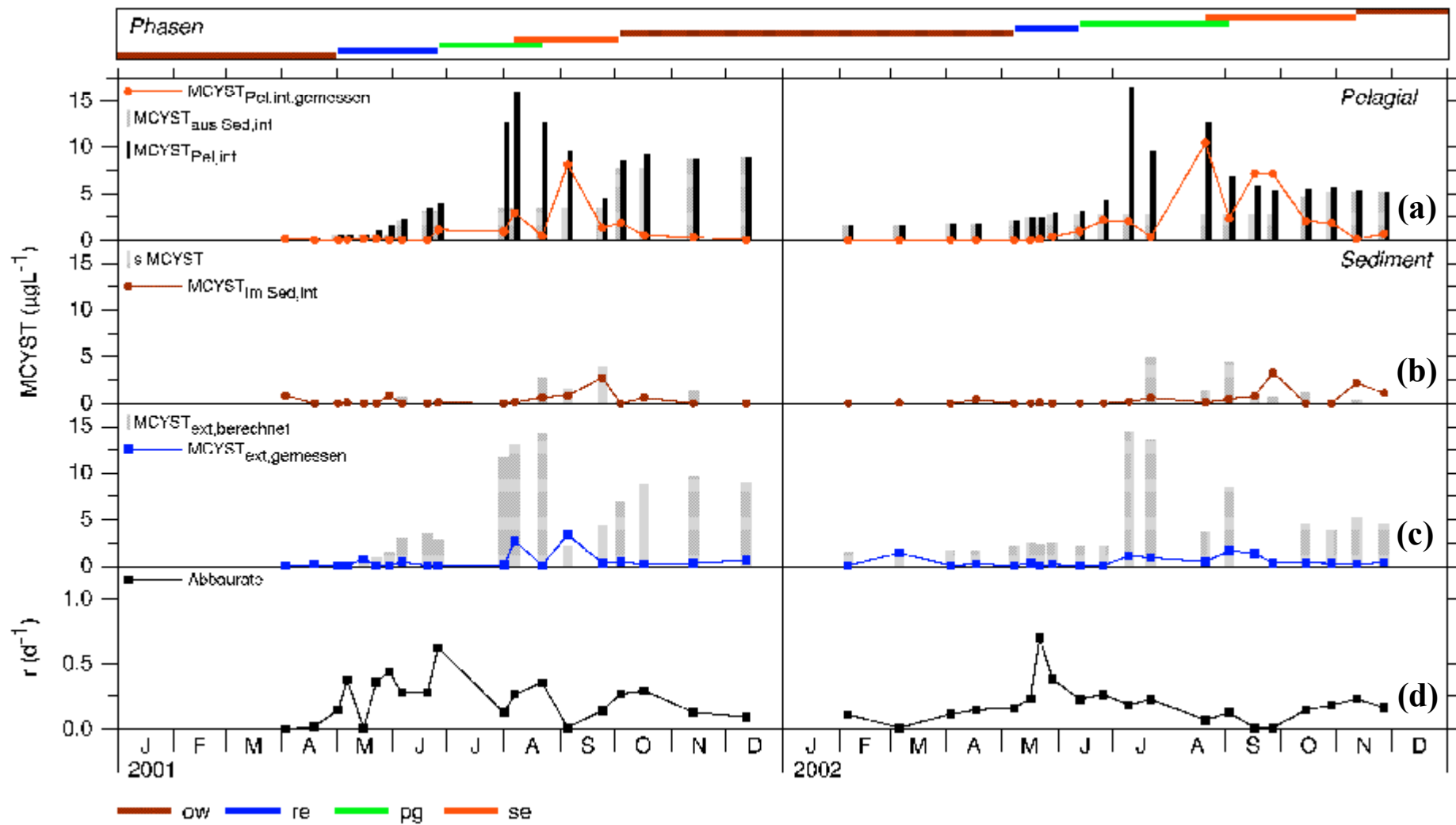
3.

test statistic

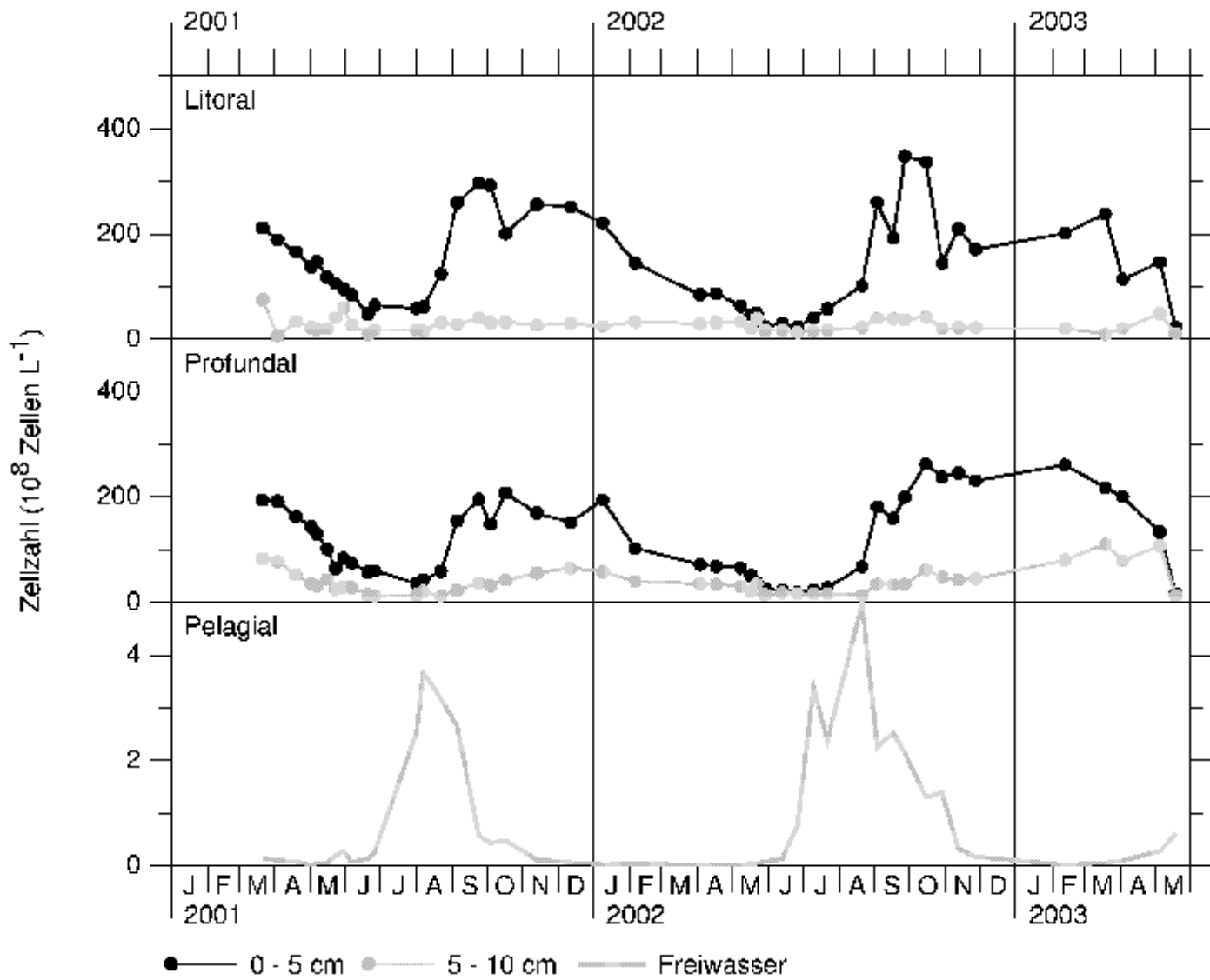
$$\text{extracellular}_{\text{calculated}} \stackrel{?}{=} \text{extracellular}_{\text{measured}}$$



with pH-threshold



without pH-threshold



losses during reinvasion...grazing by zooplankton ?



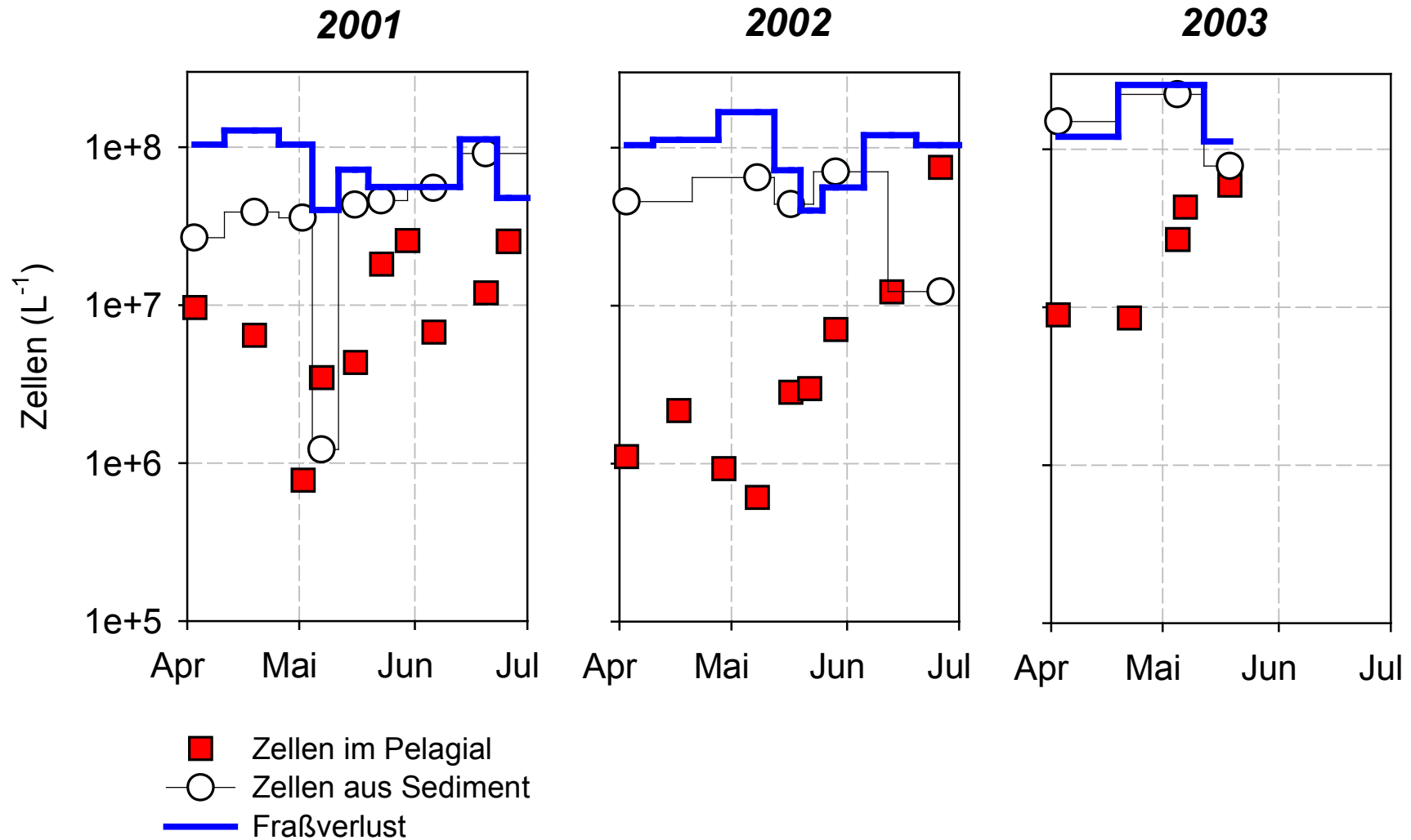
...a simple arithmetical example:

Adrian (1991): *Cyclops vicinus* ingestion rate $\approx 400 \text{ ng DW ind}^{-1} \text{ h}^{-1}$
 $\approx 200 \text{ ng C ind}^{-1} \text{ h}^{-1}$
 $= 4800 \text{ ng C ind}^{-1} \text{ d}^{-1}$
 $= 4.8 \text{ } \mu\text{g C ind}^{-1} \text{ d}^{-1}$

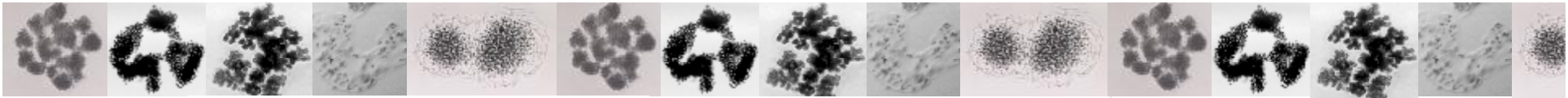
abundance: $50 \text{ ind. L}^{-1} \approx 240 \text{ } \mu\text{g C L}^{-1} \text{ d}^{-1}$

phytoplankton: $1 \text{ mg L}^{-1} \approx 0.5 \text{ mg C L}^{-1}$

losses during reinvasion...grazing by zooplankton ?



but: no permanent deficiency of food & appearance of extracellular MCVYST !!!



Microcystis: benthic-pelagic interactions have a temporal scale exceeding one season

