Institute of Geology AS CR, v. v. i.

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MERCURY DISTRIBUTION AND FLUXES IN MOUNTANIOUS LAKE ECOSYSTEM SEVERELY DAMAGED BY THE BARK BEETLE INFESTATION

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with contribution of:

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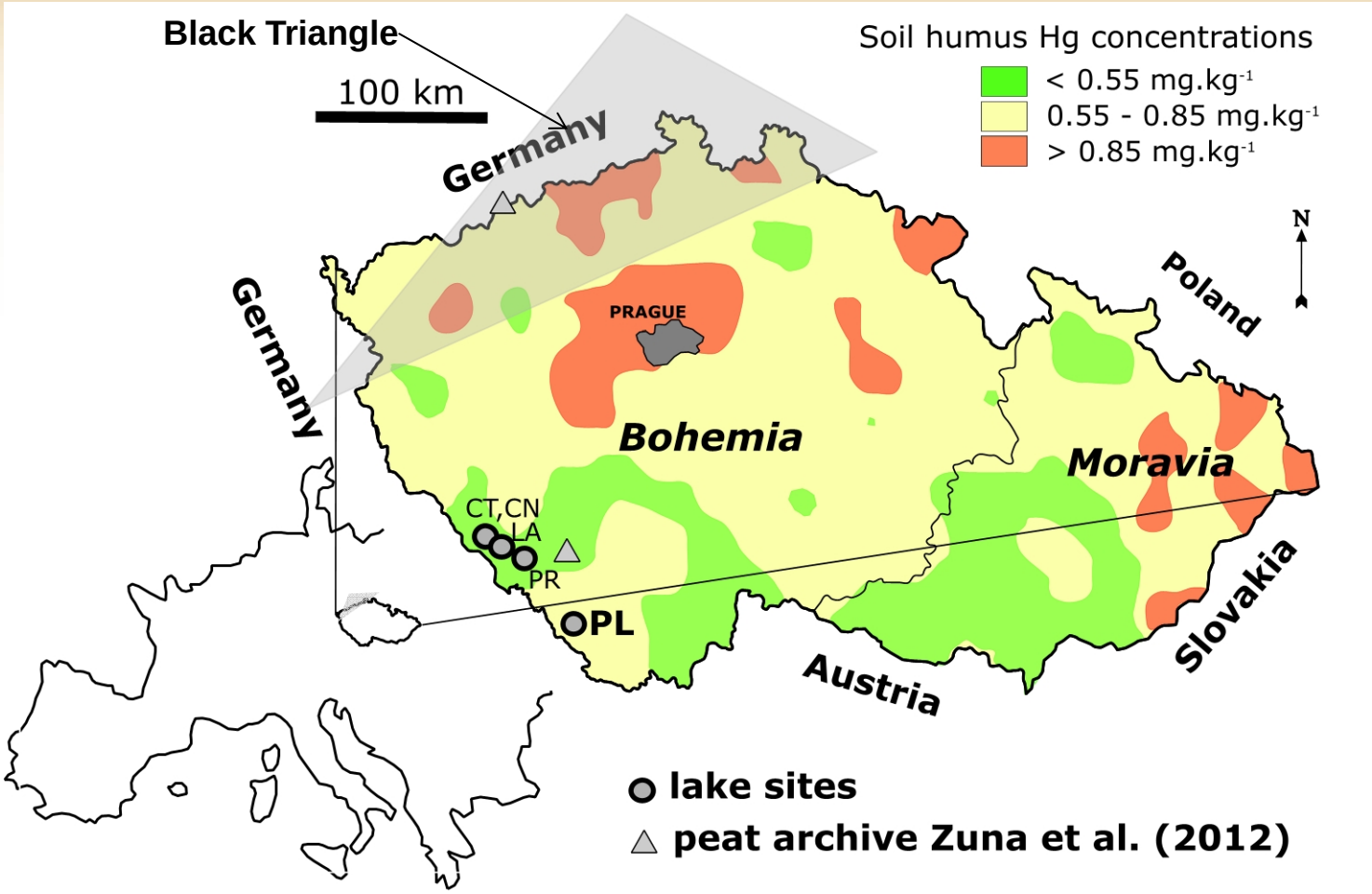
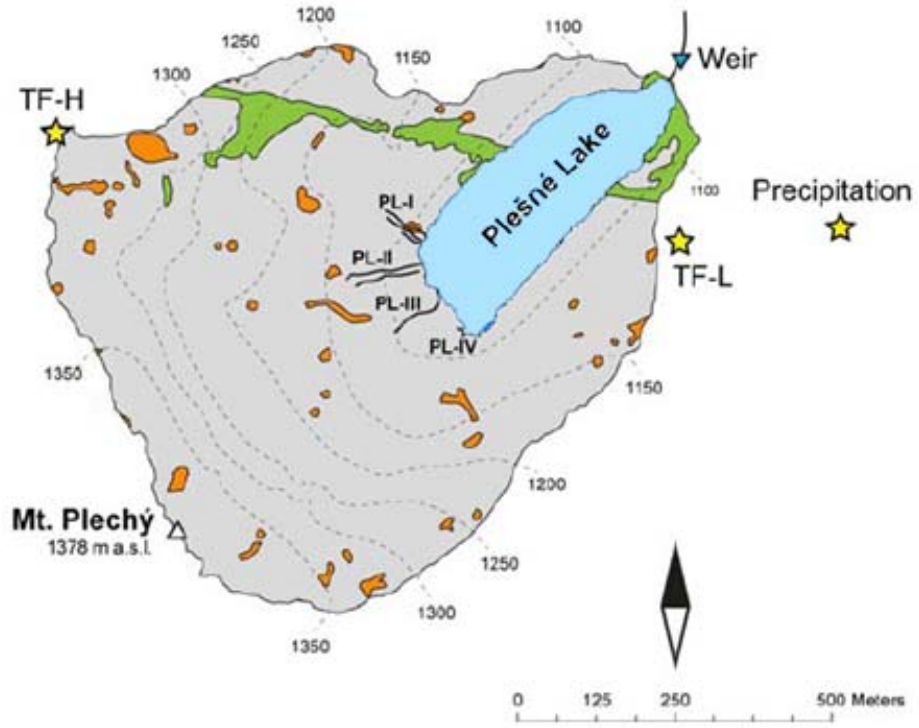
the Czech Republic, Central Europe



Isolines in the perimeter of the Czech Republic denote Hg forest humus concentrations in 1995 survey

Source: Suchara I, Sucharová J (2002) - *Water, Air and Soil Pollution* 136.

Plešné lake



- areas with >80% reduction of living spruce trees due to bark beetle outbreak during 2004–2008
- areas with damaged forest in 2000
- healthy forest

Source: Kopáček et al. (2017) *STOTEN* 584-585

Site in National Park area since 1991 no management activities allowed

General data - lake

oligotrophic lake

elevation	1089 m a.s.l.
glacial origin	(> 14,000 yrs old)
area	7.6 ha

four tributaries

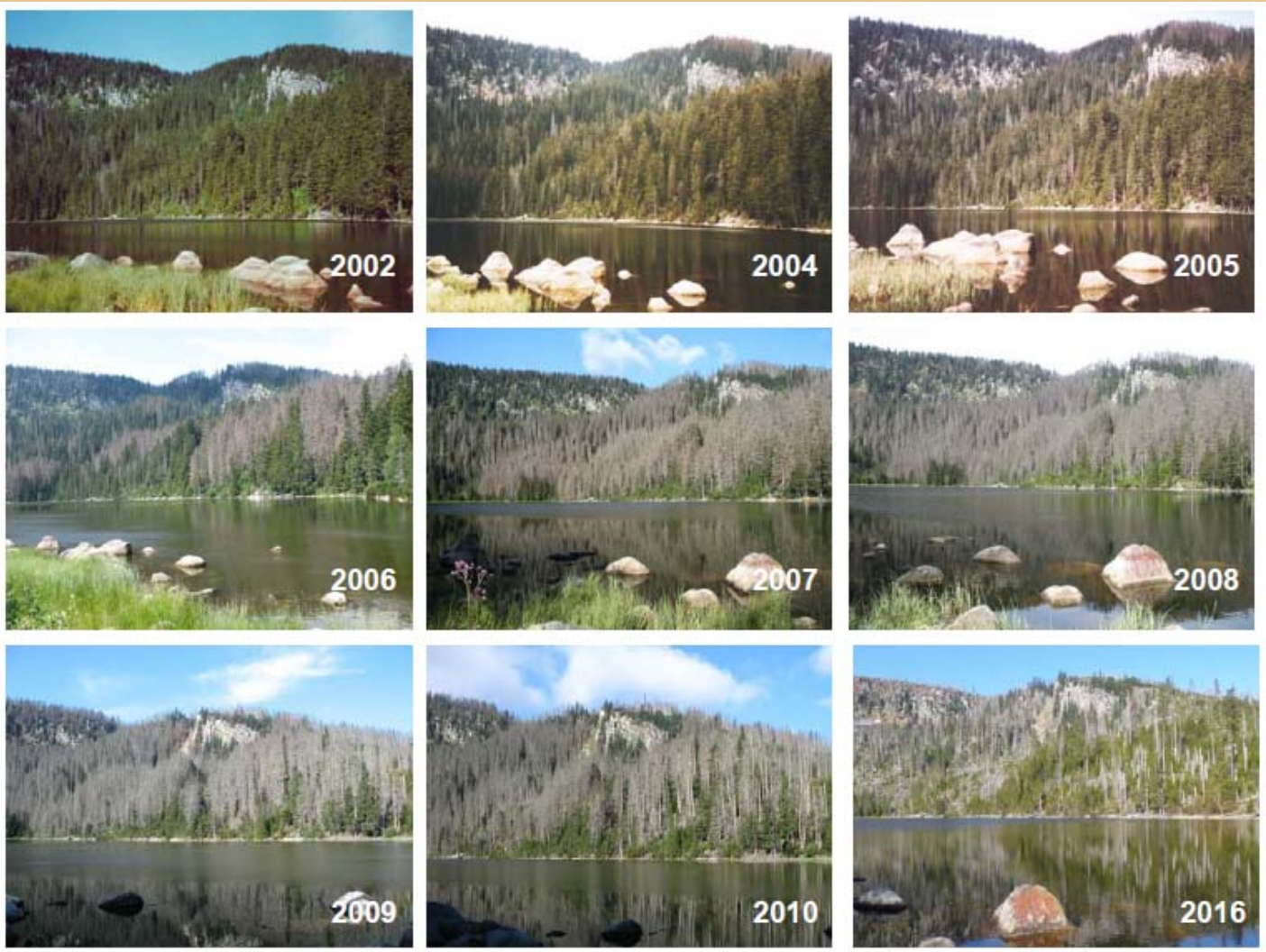
General data - catchment

bedrock	granite
max local relief	288 m
area	67 ha

vegetation

* in year 2000	90% spruce forest
* in year 2013	93% area lost 80% healthy spruce

Plešné lake, bark beetle infestation



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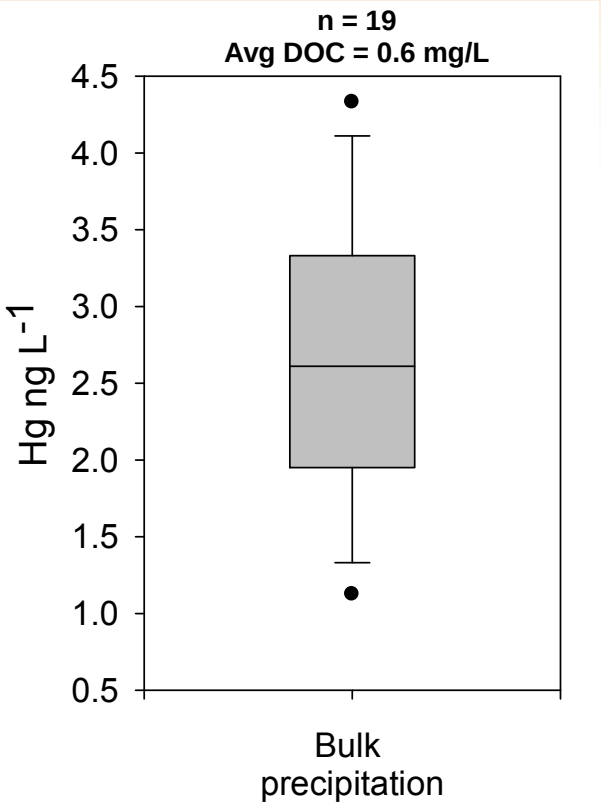
Wet Hg deposition



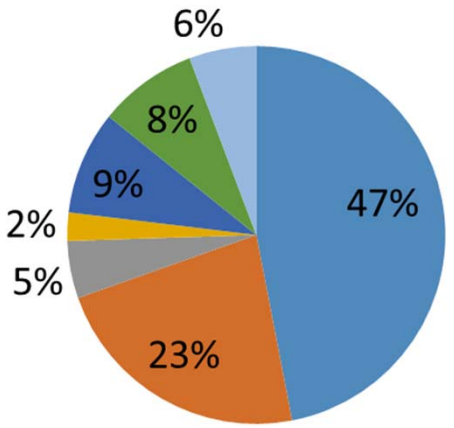
Mean precipitation
1188 mm

Hg wet deposition in 2016
2.91 µg/m^2

wet deposition
~ 10-20% of total

Major part of deposition
~ 80-90% of total ⇒ litterfall….

Litterfall



- sampled twice a year in winter & summer
- 5 individual traps at each site

- 4 sites in total
  - 2 sites in infested areas,
  - 1 site in healthy forest
  - 1 reference site at CT lake catchment

Average Hg concentrations

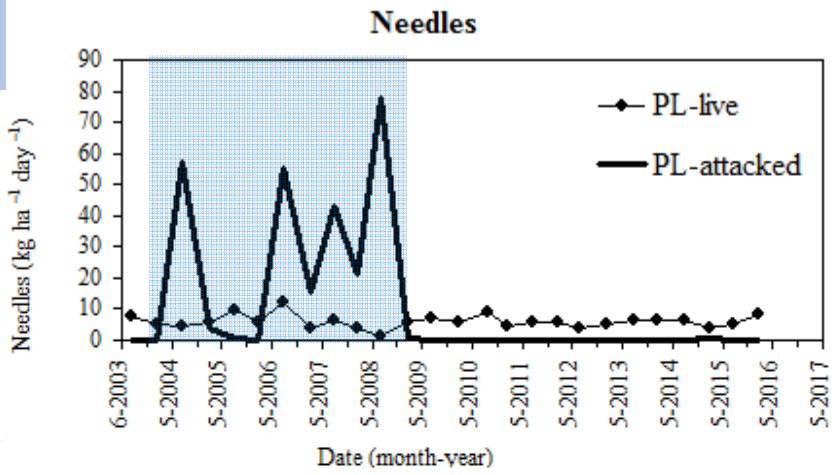
•needles	76	µg/kg
•twigs	85	"
•bark	122	"
•lichen	233	"
•cones	32	"
•mix	170	"
•leaves	42	"

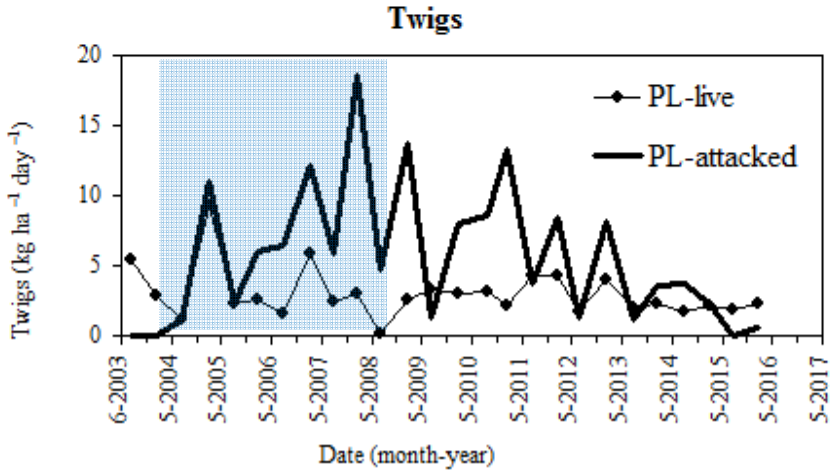
Source: Kopáček et al. (2015) *BOREAL RESEARCH* 20

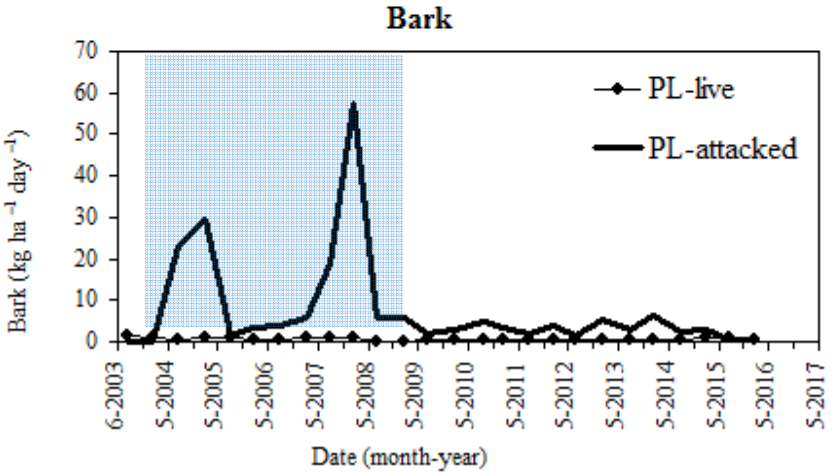
Litterfall changes due to infestation

- two data points per year

2004-2008	Litter kg/ha/yr
PL-live	4772
PL-attacked	21995
CT-live	3596





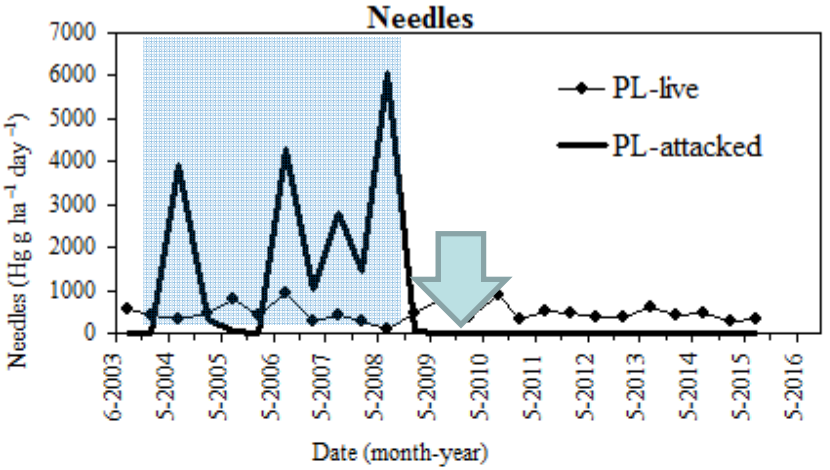


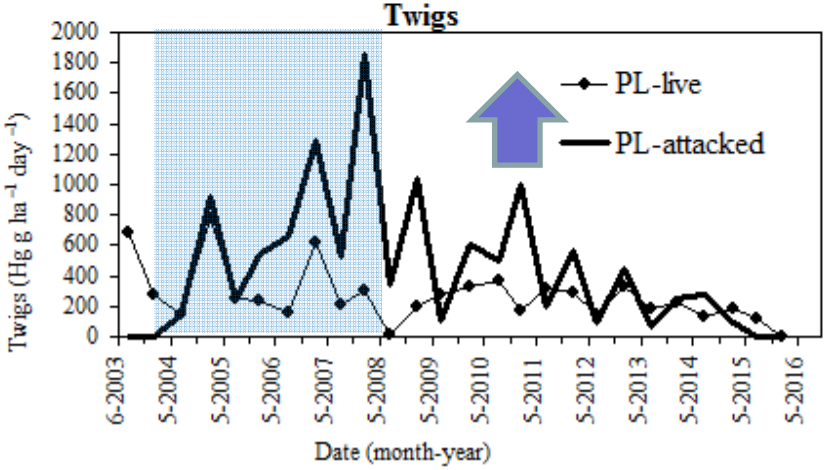
Source: Kopáček et al. (2015) *BOREAL RESEARCH* 20

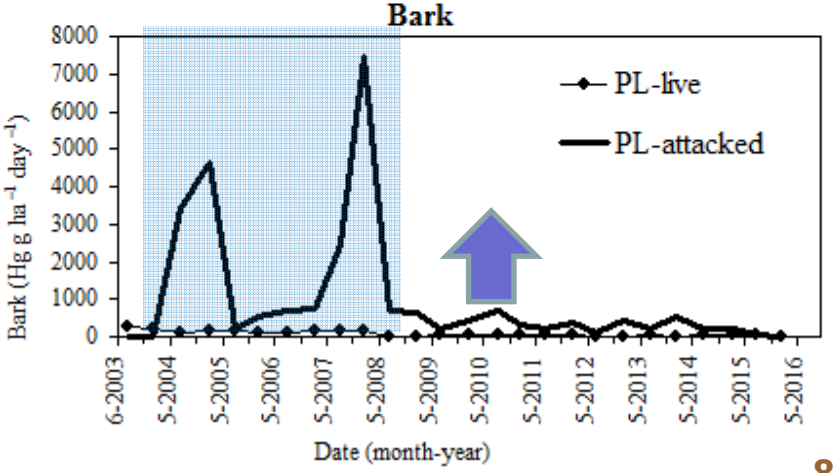
Litterfall Hg fluxes

- two data points per year

2004-2008	Hg µg/m^2/yr
PL-live	37
PL-attacked	197
CT-live	26







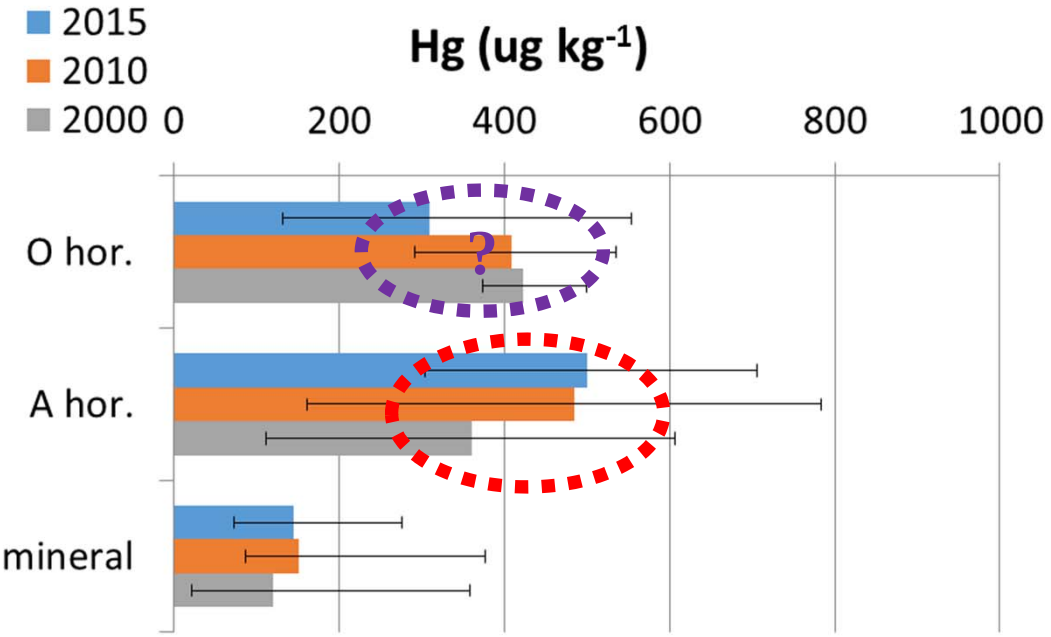
Soil

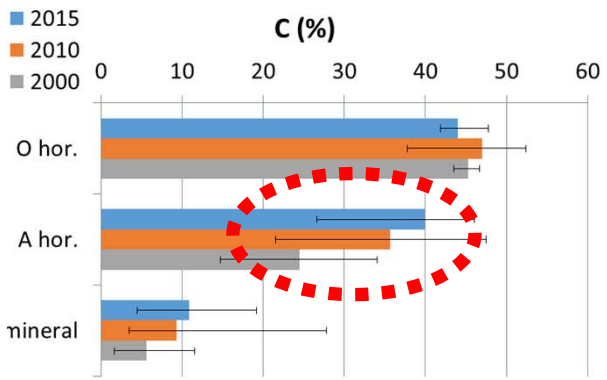
3 major surveys 2000, 2010 and 2015 (20 soil pits each)

General data – soil

leptosol, podsol, dystric cambisol

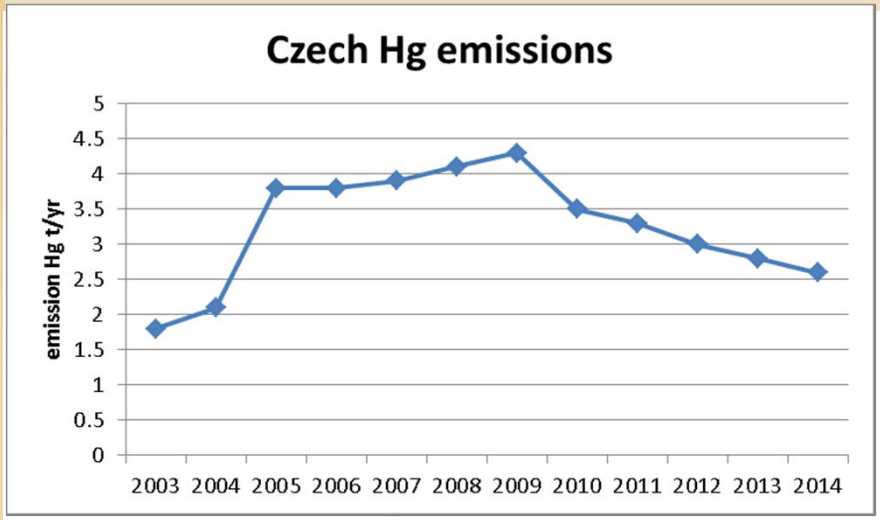
0.20 to 0.45 m deep

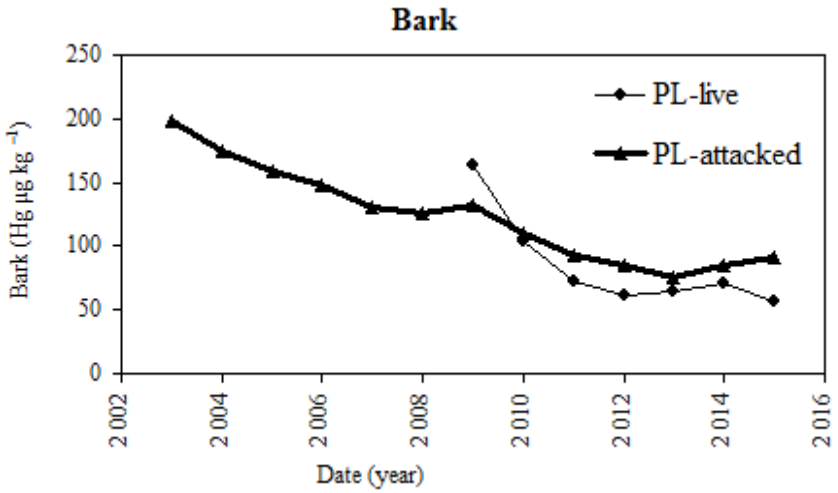


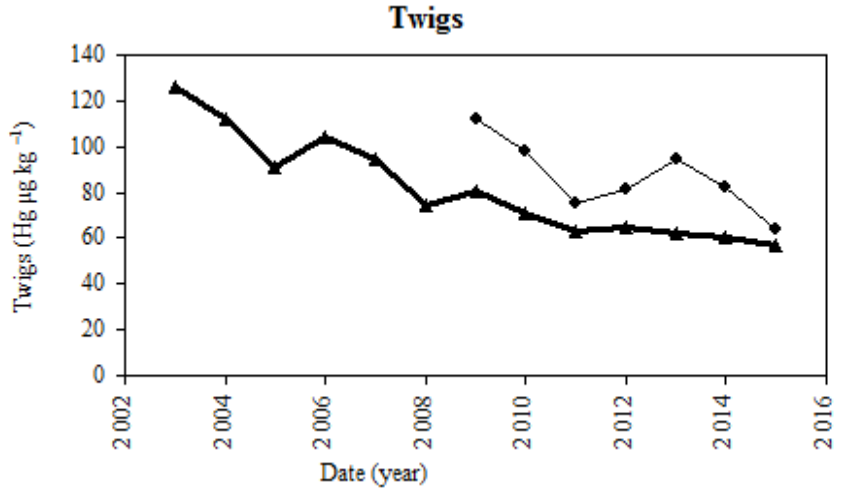


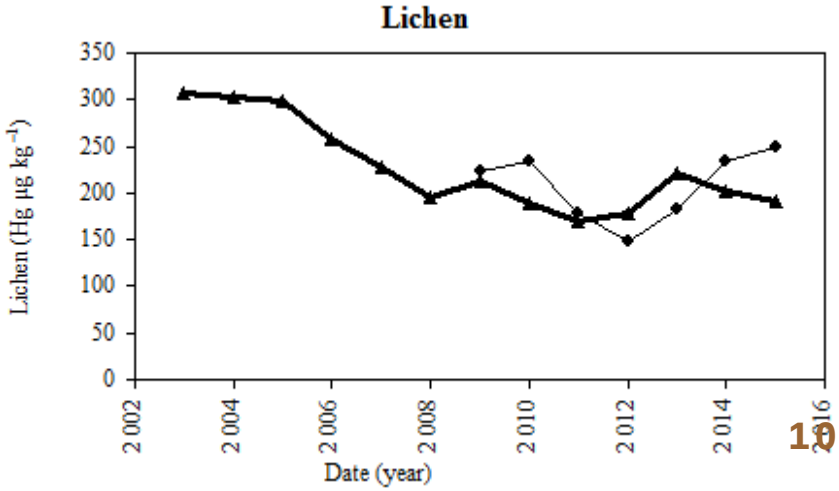
Source: Kopáček et al. (2002) *Silva Gabreta* 8

Soil Hg vs litterfall input



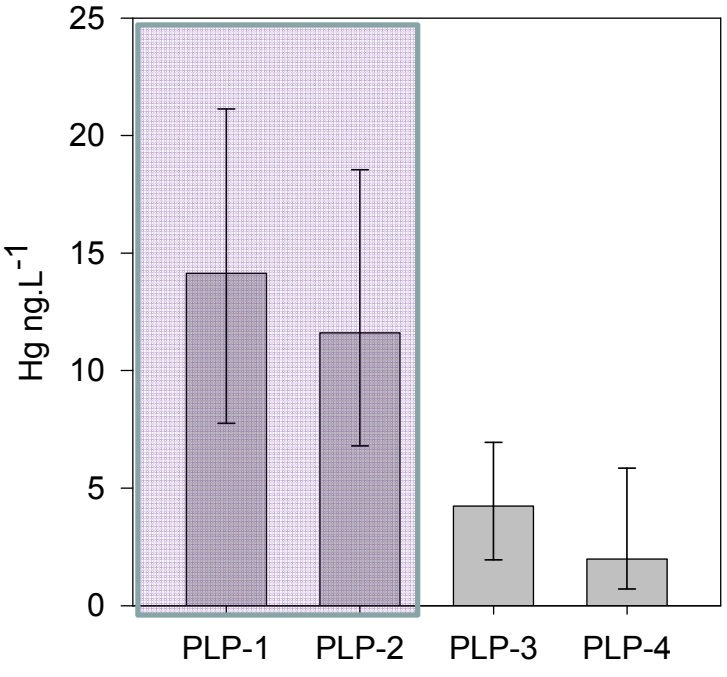


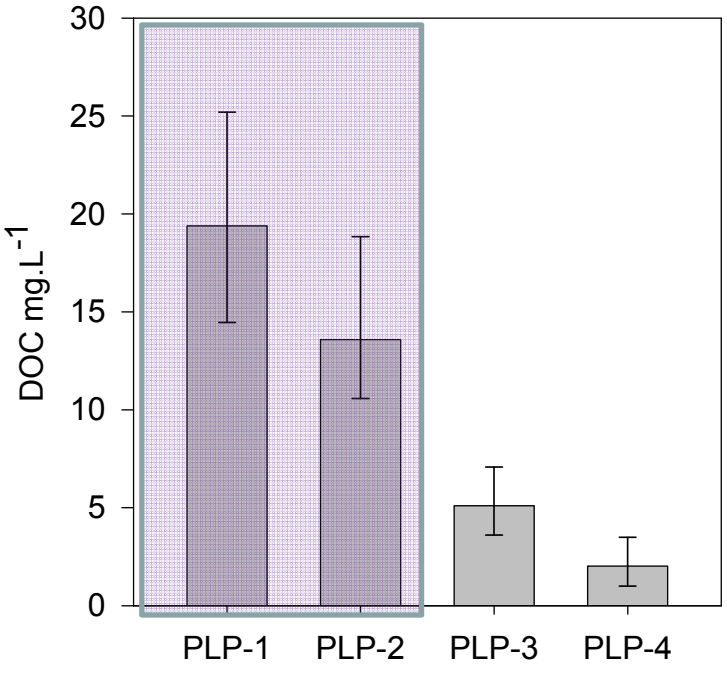




Tributaries

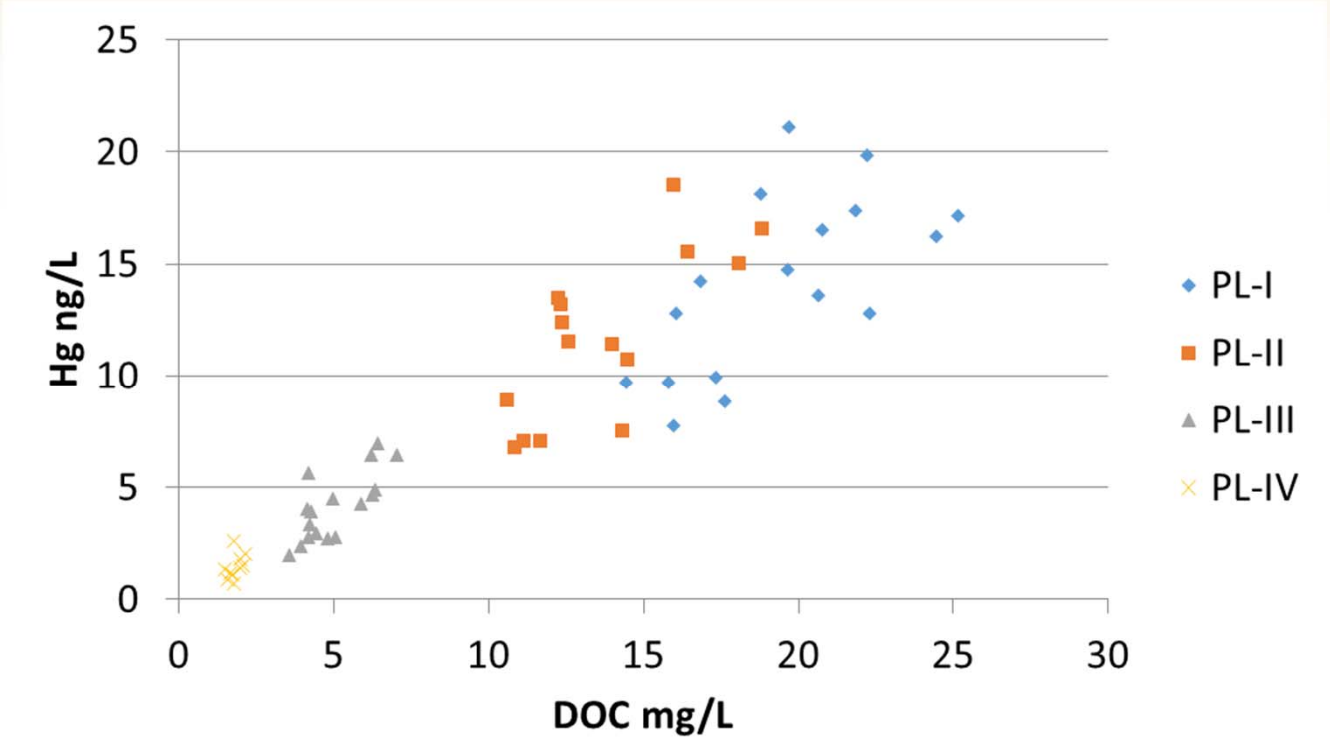
- four tributaries, sampled with approx. three weeks interval
  - ***2 dominated by surface flow***
  - ***2 dominated by groundwater flow***





Stream water Hg and DOC

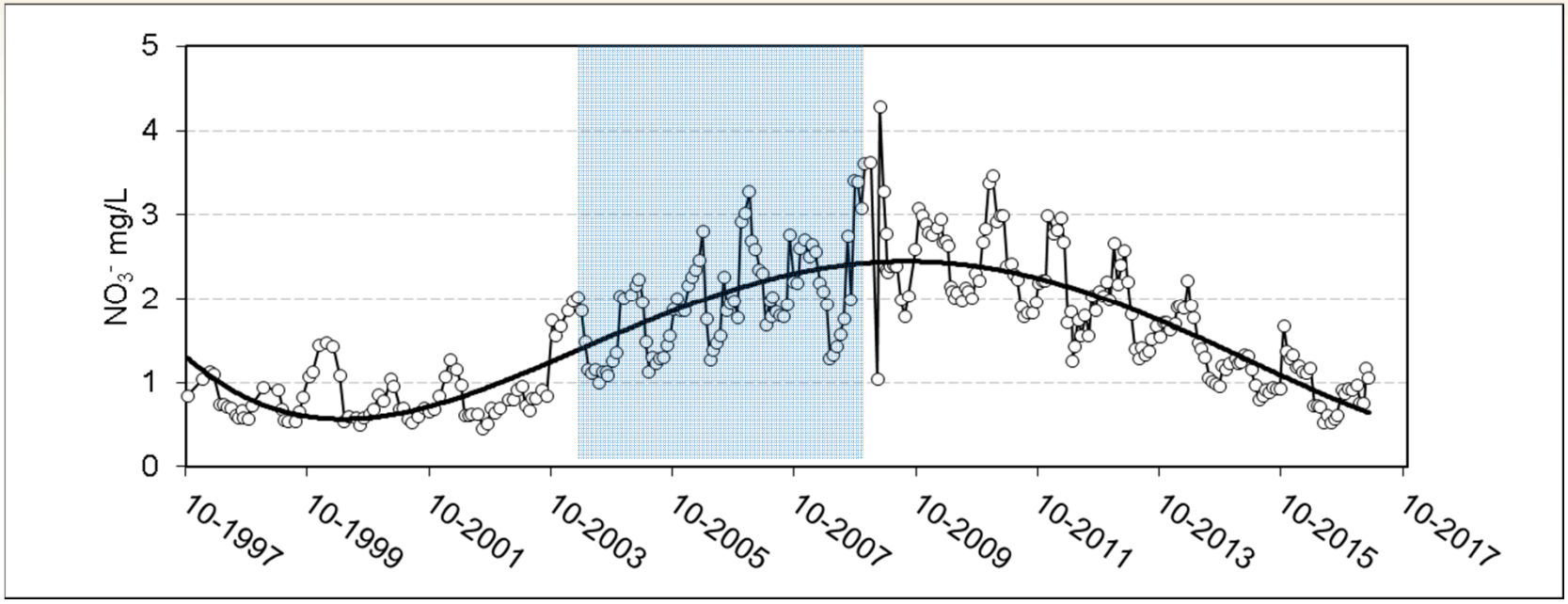
- four tributaries, sampled with approx. three weeks interval



- Hg export to lake determined by DOC

Changes of inlet water quality

- deposition ⇒ soil ⇒ soil solution ⇒ stream solution
  - long-term data representing period 1997-2016



- increase in NO_3 ⇒ microbial decomposition of incoming litter and absence of uptake by trees
- increase in DOC ⇒ increase in soil moisture due to decreased evapotranspiration Hg
- should increase concurrently to DOC (assuming no changes of Hg/DOC after infestation)…

Source: Kopáček et al. (2017) *STOTEN* 584-585

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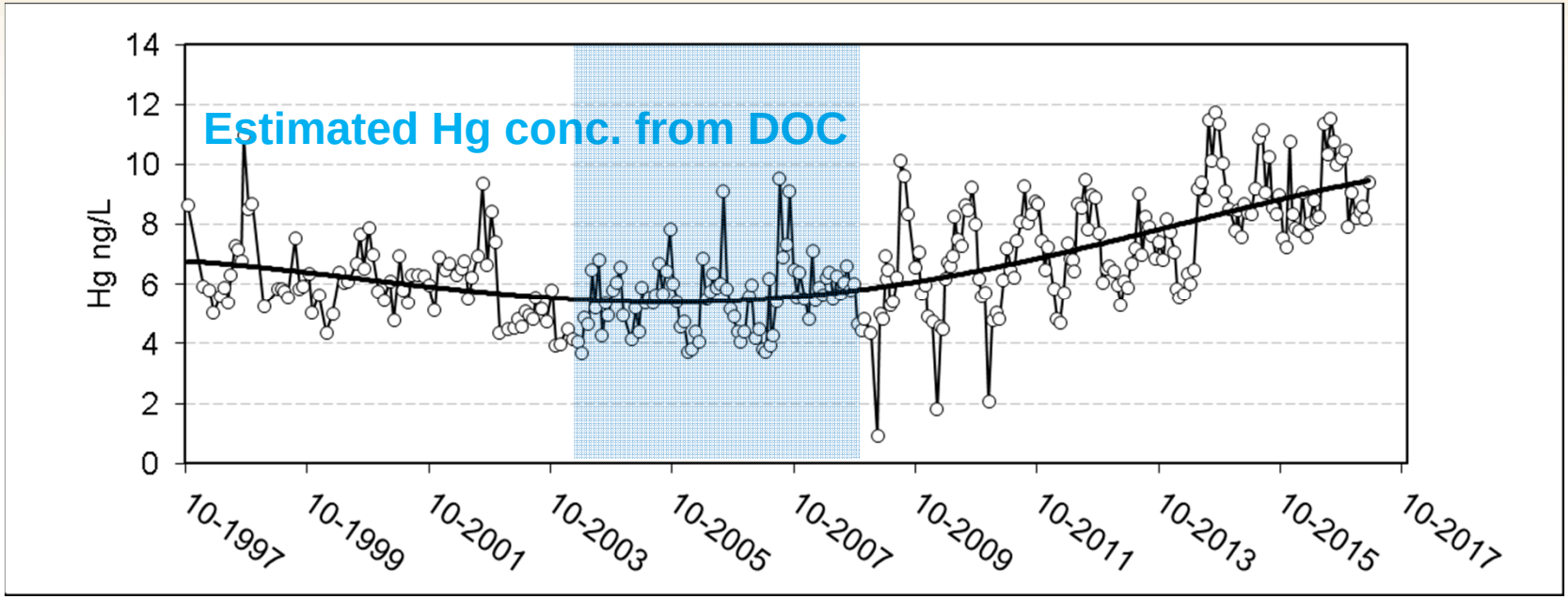

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Conclusions

- infestation resulted in temporal 5-fold increase in litterfall Hg deposition flux
- Hg concentrations in O-horizons decreased due to decrease of Hg in the incoming litter material (occurring also at reference site)
- Hg concentrations in A horizons increased concurrently with total carbon (TC) this could be due to infestation
- DOC tributary input to lake increased by ~30% due to infestation therefore Hg input to the lake increased concurrently

This study of mercury in forest ecosystem was supported by project GA16-14762S of the Czech Science Foundation and from the institutional resources of the Institute of Geology ASCR v.v.i.
Long-term monitoring of Plešné lake ecosystem was supported by numerous projects of the Czech Science Foundation to researchers of Biology Center ASCR v.v.i.