

# Invertebrate animals in Danish drinking water distribution networks

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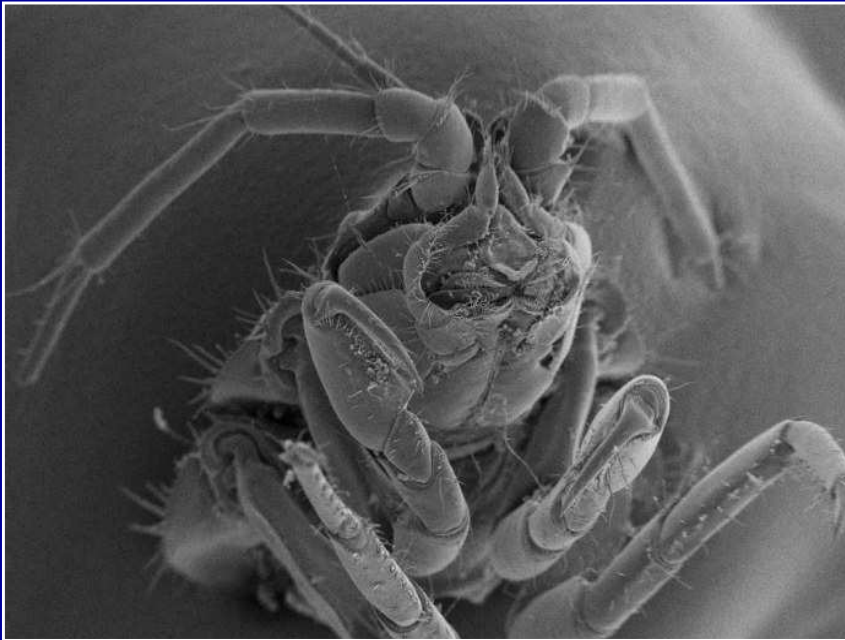
# Background

- Invertebrates
- Present in distribution systems worldwide
  - Hosts for parasites
  - Aesthetic problems
- Effects on microbial water quality?



(WHO, 2004: Safe piped water: managing microbial water quality in piped distribution systems)

# Background - Denmark



***Asellus aquaticus***

[www.uni-kiel.de/zoologie/institut/limnologie/bilder.htm](http://www.uni-kiel.de/zoologie/institut/limnologie/bilder.htm)

# Aims

- To develop sampling techniques for pipes and clean water tanks
- To examine the abundance of invertebrates in a drinking water supply system
- To identify parameters influencing the occurrence of invertebrates in the distribution system

# Methods – sampling from pipes

- Flushing from fire hydrants
- Laminar flow (Reynolds  $<2100$ ): non-adhering species
- Turbulent flow (Reynolds  $>2100$ ): well adhering species
- Swabbing (150 m plastic pipe)
- 2 m pipe cut out and examined



# Methods – preparation and analyses

- Filtration through 500, 100 and 20  $\mu\text{m}$  nets
- Stereo microscopy



# Sampling procedures - Results

- Flushing
  - Laminar flow – *Tubifex* (oligochaete worm)
  - Highly turbulent flow – *Asellus* (water louse)
- Swapping – *Asellus* and *Tubifex*
- Cut out piece of pipe
  - no invertebrates



# Methods – sampling in clean water tanks

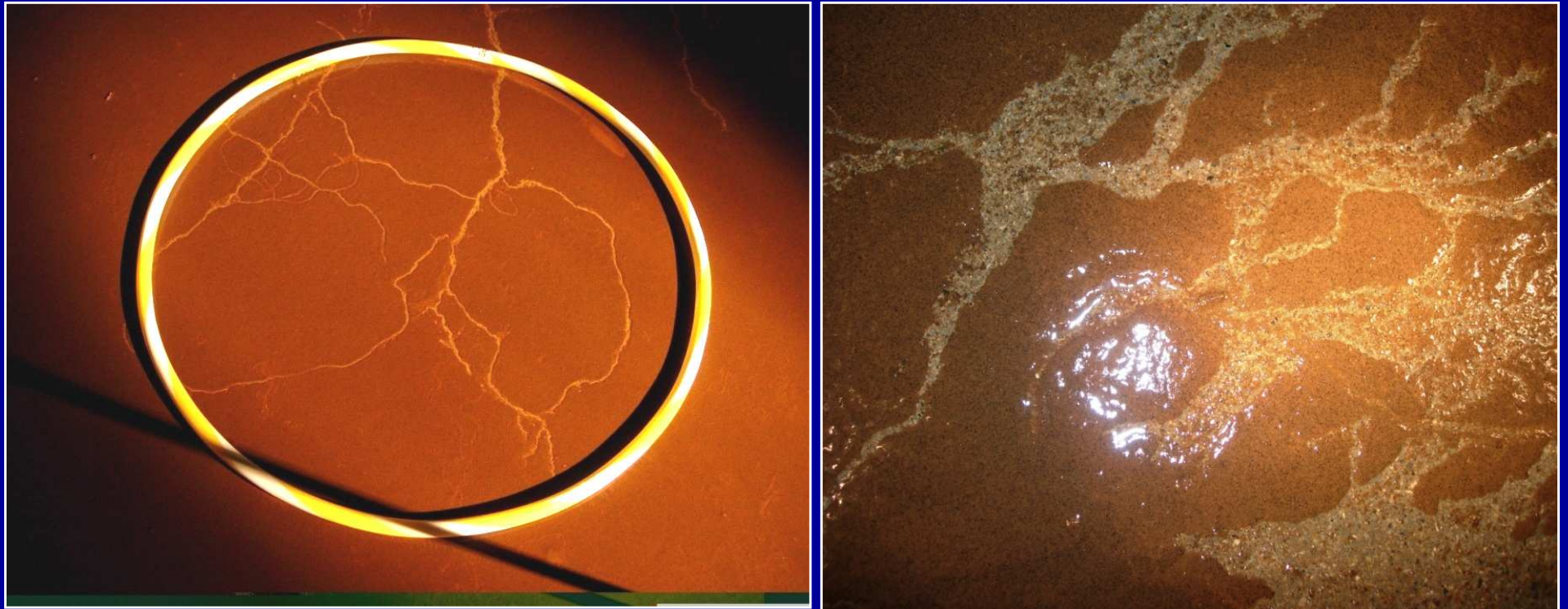


Tank volume: 35,000 m<sup>3</sup>

# Methods – sampling in clean water tanks



# Results – clean water tanks



One *Asellus* in 20 random samples (8 m<sup>2</sup>)

# Results – clean water tanks



213 *Asellus* in the flush channels of the second half of the tank (30 m<sup>2</sup>)

11

# Results – clean water tanks



# Sampling procedures – summarising points

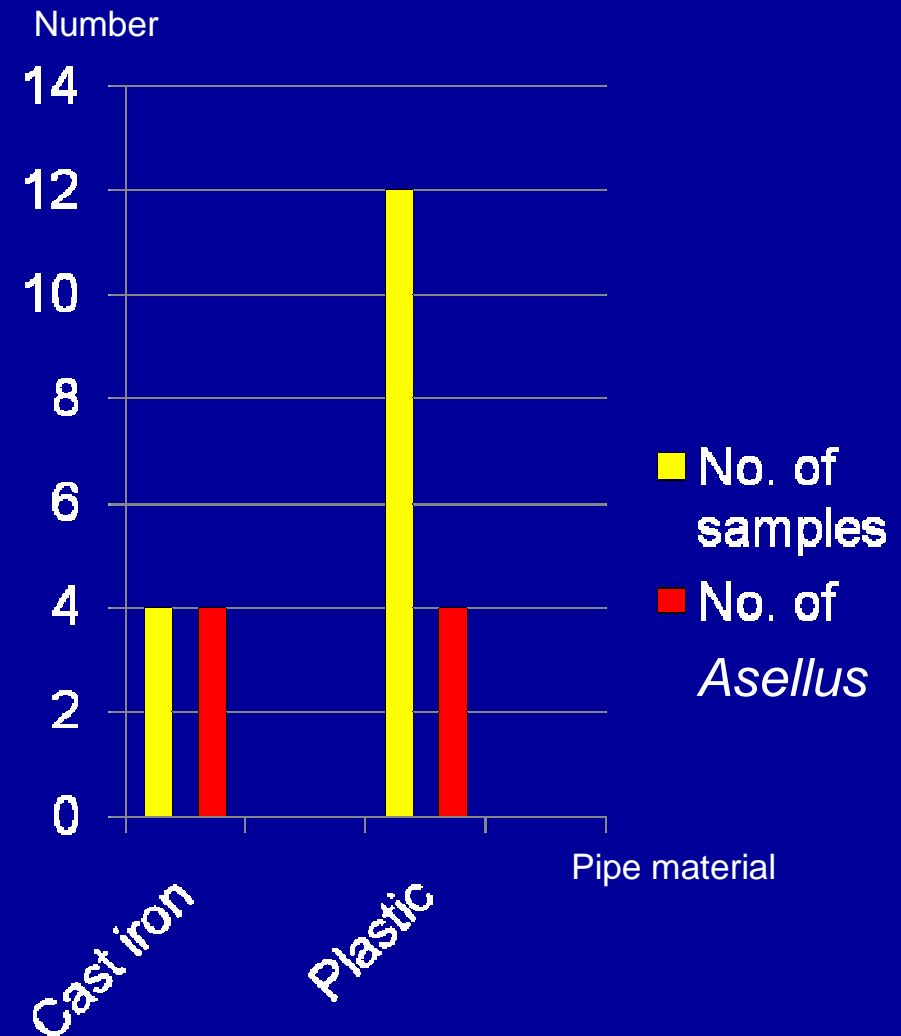
- A highly turbulent flow is necessary to flush out *Asellus* – swabbing with a sponge preferable
- Subsequent sampling at max. possible flow
- Many *Asellus* abundant in the large clean water tank

# Parameters influencing occurrence of *Asellus*?

- Pipe materials?
- Placement in the distribution system (pressure zones and distance from clean water tanks)?

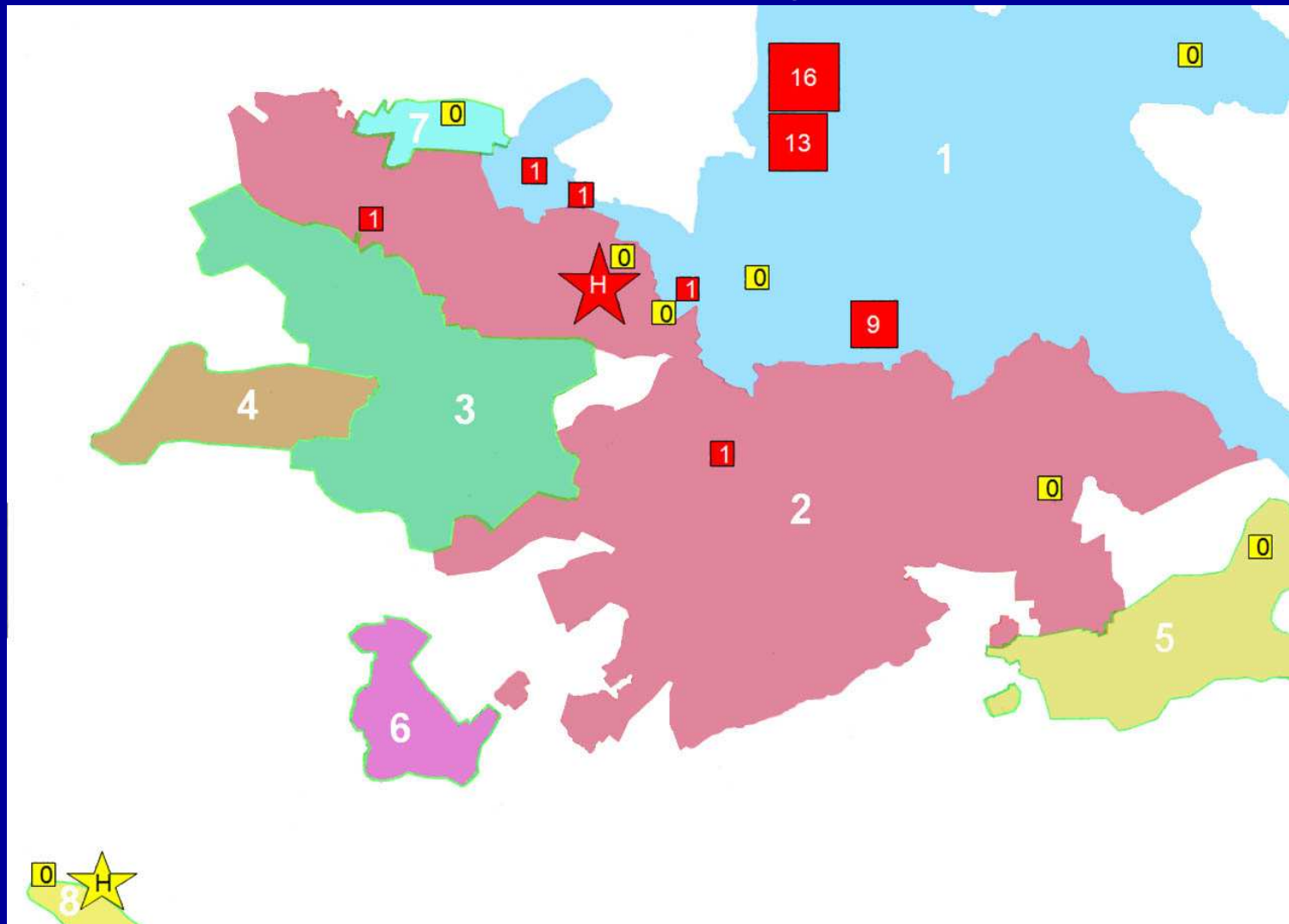
# Results – pipe materials

- Findings in both types of pipes but highest percentage in cast iron
  - old pipes
  - typically found in the old part of town located close to the clean water tank
  - many hiding places
- Low bacterial numbers in both pipe types



Sampling date	Locality	Pipe material	Diameter [mm]	Pressure zone	Sample volume pr. m <sup>3</sup>	<i>Asellus</i> pr. m <sup>3</sup>	Polychaetes (worms) pr. ml. filtrate	Crustaceans < 1 mm pr. ml. filtrate
07.01.08	1	PVC	63/90	1	3	0	not investigated	not investigated
11.06.08	3	PVC	110	1	3	1	3	0
15.12.08	15	GST	100	1	1	9	0	0
11.06.08	5	BON/PE	500/110	1	2	0	not investigated	not investigated
25.06.08	4	GST	100	1	2	1	0	0
23.10.08	8	PE	90	1	1	0	not investigated	not investigated
23.10.08+ 15.12.08	9	GST	80/100	1	1	9 + 16	0	0
23.10.08	7	PVC	90	1	1	1	0	1
15.12.08	17	GST	100	1	1	14	0	0
24.04.08	Tank 1A			1		39	2	0
21.07.08	Tank 1B			1		211	0	1
23.10.08	11	PE-80	160	2	1	1	1	0
23.10.08	6	PVC	90	2	1	0	0	1
23.10.08	10	PVC	110	2	1	1	0	1
15.12.08	14	PVC	90	2	1	0	5	0
15.12.08	16	PVC	90	5	1	0	0	3
14.01.08	2	PEM	200	7	2	0	not investigated	not investigated
15.12.08	13	PVC	90	8	1	0	0	1
09.10.08	Tank 2			8		0	not investigated	not investigated

# Occurrence of Asellus in the distribution system



# Summarising points

- Invertebrates are abundant in the supply system in both pipes and a clean water tank
- Flushing experiments show that non-adhering invertebrates are caught at laminar flow and adhering at turbulent flow
- Invertebrates live in both iron and plastic pipes – higher percentage in iron
- Presence of invertebrates in the distribution system is influenced by the location in the distribution system (distance from tank, pressure pumps)

# Perspectives

- Food source of *Asellus*
- Lab. experiments on the association between invertebrates and bacteria (grazers or hosts?)

# Thank you



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